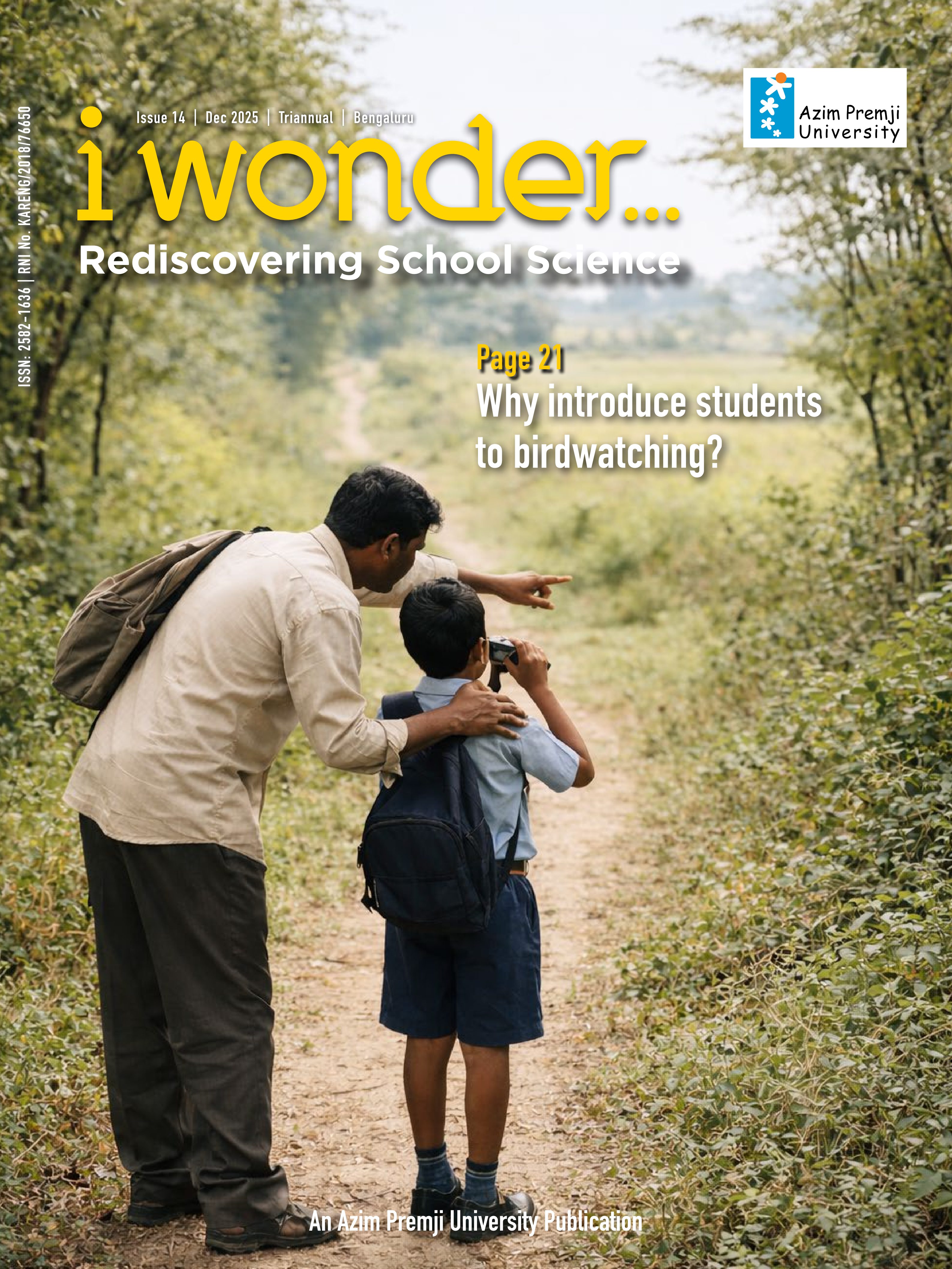
ISSN: 2582-1636 | RNI No. KARENG/2018/76650

Issue 14 | Dec 2025 | Triannual | Bengaluru

Azim Premji University

i wonder...

Rediscovering School Science



Page 21

Why introduce students to birdwatching?

An Azim Premji University Publication

Chief Communications Officer and Managing Editor: Sudheesh Venkatesh.

Publications Team: Meera Prabhu, Shahanaz Begum, Lokram V G, and Sambit Mahapatra.

Translations Editors: Madhukara S Putty (Kannada) and Rajesh Utsahi (Hindi).

Illustrations and Artwork: Vidya Kamalesh.

Designers: MAP Systems, Bengaluru, Karnataka.

Printers: Repromen, Bengaluru, Karnataka.

Editorial Office: Azim Premji University, Survey No. 66, Burugunte Village, Bikkanahalli Main Road, Sarjapura, Bengaluru 562125.
Email: publications@apu.edu.in | Website: https://iwonder.azimpremjiuniversity.edu.in/

About us: i wonder... is an Azim Premji University publication. Our aim is to publish articles and resources (like activity sheets, teacher's guides, posters, and booklets) that support the classroom instruction of preparatory-stage (Grades III-V) Environmental Studies (EVS) and middle-stage (Grades VI-VIII) science teachers. We present critical perspectives and pedagogical approaches that are aligned with the broader curricular goals and competencies that the National Curriculum Framework for School Education (NCF-SE) 2023 recommends for children at these stages of schooling.

To:

- Download a soft copy of this issue, visit: https://azimpremjiuniversity.edu.in/iwonder.
- Share your feedback on this issue, visit: https://forms.gle/hS93N5YuRHpiJidC9.
- See details on our submission guidelines, turn to the **Write for Us** section on page 80 of this issue.
- Share your questions or suggestions, write to us at: iwonder@apu.edu.in.

Cover image credits:

- **Front cover:** Teacher and student exploring birds in the neighbourhood. Credits: The image was created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Jan 2026). License: CC BY-NC-ND.
- **Back cover:** The Milky Way near Sagittarius and Scorpius, rendered with attention to real star patterns and visibility from Indian latitudes. Credits: The image was created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Jan 2026). License: CC BY-NC-ND.

Please note:

- All views and opinions expressed in this issue are that of the authors. Azim Premji University and Azim Premji Foundation bear no responsibility for the same.
- To cite our articles, please use the following format: Author name (Year of publication). Name of article. i wonder... (Issue number): Page numbers. ISSN 2582-1636. URL: Link from the university repository (https://publications.azimpremjiuniversity.edu.in/view/university_publications/fiel18=2E1/).
-

Editorial

Welcome to this issue of i wonder…. This issue features an article on an important—but often less discussed—theme from the middle-stage science curriculum: adolescence.

Adolescence is often described as a bridge between childhood and adulthood, a phase in which physical, emotional, and social changes come together to shape the future adult. While a dedicated chapter in the middle-stage science curriculum focuses on these changes, many science teachers hesitate to teach it in the classroom. Deep-rooted sociological, cultural, and pedagogical barriers—often reinforced by teachers' own discomfort—limit open discussion. As a result, this chapter and related topics are sometimes skipped or addressed superficially, leaving students without guidance during a critical phase of development.

In the article, 'Using Science to Support Students in Navigating Adolescence', Anita Rawat offers a thoughtful and compelling perspective on how science education can support students during this transformative stage. Drawing on her own experience of adolescence, Anita recognises it as one of the most sensitive phases of life. Adolescents grapple with hormonal changes, identity formation, and social pressures. They experience strong emotions but often struggle to express their concerns openly, fearing judgment or misunderstanding. Through classroom strategies such as guided self-reflection on personal changes and the use of an anonymous question box, Anita creates spaces where students feel safe to voice sensitive questions and concerns. Her approach is both empathetic and practical. By taking on the dual role of teacher and mentor, she supports students in navigating the challenges they face and encourages them to seek scientific understanding in response to their questions. Through sensitive discussions on menstruation and the specific challenges adolescent girls encounter, Anita demonstrates how teachers can challenge stereotypes that limit girls' mobility, confidence, and participation, while also fostering empathy among boys. Her work shows how science classrooms can become spaces not only for learning concepts, but also for addressing deeply rooted social attitudes.

One of the most powerful messages in Anita's work is her assertion that lessons on adolescence are not optional add-ons; they are essential components of holistic education. She reminds us that the role of a science educator extends far beyond teaching concepts, formulas, or conducting experiments. It also involves preparing young people to navigate life's complexities—especially those arising from unanswered questions and unresolved emotional concerns. These include negotiating the desire for independence while still needing adult support, balancing personal judgment with peer pressure, coping with fear of rejection, managing body image concerns and comparisons with peers, navigating anxiety around friendships with the opposite sex, and wanting to try new experiences while fearing their consequences. To meet this responsibility, teachers must work through their own inhibitions, build trust with students, and engage in honest and sensitive conversations around these topics. Anita's experience serves as a call to action for science teachers: to create classrooms where science illuminates not only the laws of nature, but also the path towards responsible, confident adulthood.

Shiv Pandey
Editorial Team Member

CONTENTS

THE SCIENCE LAB

THE READER'S VOICE

PUZZLE CORNER

USING SCIENCE TO SUPPORT STUDENTS IN NAVIGATING ADOLESCENCE

ANITA RAWAT

Adolescence involves rapid physical, emotional, and social change. How can science classrooms become safe spaces for students to explore and understand these changes?

In Chapter 6 ('Adolescence: A Stage of Growth and Change') of the Grade VII science textbook (NCERT, 2025), students read that adolescence: *"...is a period of rapid growth and development, typically occurring between the ages of 10–19. During adolescence, the body prepares for adulthood."*[1] This chapter explains that *"Humans, like most other living beings, cannot reproduce immediately after their birth. Their bodies need to grow and reach a stage of maturity to be able to reproduce. As humans grow and develop, they experience significant physical, emotional, and behavioural changes, along with the ability to reproduce. Some such changes may be quite clearly observable, while others occur internally and may go unnoticed."*[1] Students at this stage of development may already have observed many such changes in themselves and their peers (see **Box 1**).[2] Often, these observations raise questions and concerns that students may hesitate to share with family members. The textbook chapter suggests some simple classroom activities that give students the opportunity to discuss these with peers and teachers (see **Box 2**).[1] I tried some of these activities with my students. I found the textbook and supporting resources from the Internet helpful in addressing several concerns and fears common to all adolescents.

Box 1. Stages in adolescence:

This stage of development is divided into three stages:

- Early adolescence: Typically, between 10–14 years of age. Marks the onset of puberty. Hormonal changes lead to a growth spurt. Students mainly demonstrate concrete operational thinking and increased self-consciousness.
- Middle adolescence: Typically, between the ages of 15 and 17. Puberty reaches its peak. During this period, students show rapid sexual maturation, develop abstract and hypothetical thinking, and strengthen their problem-solving skills. They begin to form an individual identity, experience greater peer influence, and show increased curiosity about the opposite sex.
- Late adolescence: Physical development is complete. Students show stronger formal operational thinking, better decision-making, a more stable sense of identity, and greater self-control.[2]

But they were not adequate in addressing questions that were closely tied to my students' specific social and cultural contexts and life experiences. In this article, I share some of these issues and describe the approach I used to respond to them.

Guided self-reflection on personal changes

I started the class with an activity (Activity 6.1 from Chapter 6 of the Grade VII science textbook) that encourages students to identify and reflect on the changes they observe in themselves: *"Take a jar and some paper slips. Write down the changes you can notice among students as they go from Grades 5 to 8. These could be related to height, strength, behaviour, or any other aspect. Please avoid writing names on the slips. Fold the slips and place them in the jar..."*[1] These are the responses I received:

Box 2. My analysis of the key learning outcomes of the textbook chapter:

The period between 13–17 years appears to be particularly sensitive. During this period, adolescents grapple with many rapid physical changes and an upheaval of emotional and social changes. Often, they desperately need good guidance, but are hesitant to ask for it. Including a chapter in the science textbook on this theme in middle school allows teachers to discuss these changes just before or soon after students reach this period.

Keeping this in mind, I analysed the textbook chapter to identify its key learning outcomes:

- Understand what adolescence refers to and its age range.
- Identify physical, biological, and emotional changes associated with this period.
- Explain reasons for these changes, such as the occurrence of menstruation.
- Show sensitivity towards the other gender and the experiences of others.
- Differentiate between myths and facts related to adolescence.
- Understand suggestions for a healthy lifestyle and the need for nutritious food.[1]

Based on the cultural values of the community that my students belong to and the prevalent social norms, I included the following learning outcomes:

- Adolescent girls understand and adopt steps to maintain hygiene during menstruation.
- Adolescent girls scientifically examine social and cultural beliefs related to menstruation and decide their correctness or incorrectness for themselves.
- Adolescent girls develop the confidence to tell their family members and teachers about their menstrual problems without hesitation.
- Adolescent boys develop sensitivity to the problems faced by menstruating female members of their family and can talk to them about this subject if needed.
- Adolescent boys and girls gain the confidence to share their thoughts and concerns with trusted adults who can offer guidance.
- Adolescent boys and girls develop an understanding of the responsibilities they will take on in their future lives.

- All students reported an increase in height and weight.
- Many students reported differences in physical build. These included the broadening of shoulders and chest in boys, and the broadening of hips and appearance of breasts in girls.
- Many reported that their voice had become heavier.
- Some students mentioned having acne.
- Many students mentioned seeing hair grow from certain parts of their bodies. For example, boys mentioned the appearance of moustaches.
- Girls mentioned the onset of menstruation.
- Some girls mentioned seeing white discharge from their vagina (called leucorrhoea).

I used the textbook and short, student-friendly video resources to discuss these physical changes with students.[3] Specifically, I drew their attention to this passage in their textbook: *"Many changes in adolescence, including menstruation and other signs of puberty, are mainly due to* **hormones***—certain chemicals produced in our bodies. Hormones play a crucial role in regulating various aspects of growth and development, contributing to the proper functioning of the body. They are produced in different parts of the body and are released at an appropriate time in response to signals from the brain."*[1] By discussing how reproductive hormones act differently in male and female bodies, I emphasised that the changes students were noticing in themselves were a normal part of development. I also highlighted that some changes during adolescence are internal and may not be immediately visible.

Questionnaire to explore beliefs on menstruation

The textbook tells students that the menstrual cycle is an: *"...important internal change associated with adolescent girls... It recurs generally every 28–30 days and is more commonly known as 'the period'. Many healthy girls may have longer or shorter menstrual cycles, ranging from 21–35 days. The menstrual cycle is an important natural process and is one of the signs of good reproductive health."*[1] But students can often hold misconceptions about menstruation (see the **Activity Sheet** and **Student Handout I**). To identify these, I designed a questionnaire to assess adolescents' knowledge and sensitivity regarding the challenges faced by menstruating girls and women. The questions focused on physical and emotional discomfort, personal hygiene practices, and related social concerns. Students were encouraged to respond based on their own experiences. An analysis of their responses revealed the following:

- Over half the girls reported using reusable cloth pads during menstruation.
- Most of the girls reported experiencing physical discomfort (such as abdominal and back pain, pain in the hands and feet, fatigue, etc.) and feelings of sadness during menstruation.
- Many of the girls shared that family members restricted them from touching certain food items (such as pickles and the dried lentil dumplings called *badi*), eating sour foods, drinking cold water, and participating in running-intensive sports during menstruation. Two of the girls reported that they were restricted from bathing during this period.
- All the girls described menstruation as a source of shame, with most expressing anxiety about having blood stains on their clothes that would be seen by others.
- Responses from the boys clearly indicated that they had limited awareness of the physical and emotional challenges faced by menstruating girls and women.
- Nearly 80% of the boys reported that they had never discussed menstruation with female family members or classmates (see **Student Handout II**).

I began the next class by asking the students to consider the challenges faced by adolescent girls and adult women during menstruation. Seeing that the boys contributed little to the discussion, I read aloud the girls' responses and discussed them in detail. My aim during this discussion was to build an understanding of the following:

- Menstruation is a natural process. Menstruating every month is a sign of good reproductive health.
- It is important to pay attention to personal hygiene during menstruation. Hygiene is not only about maintaining the cleanliness of the body, but also of the undergarments and the cloth/sanitary pads used during this period. If adolescent girls use cloth pads during menstruation, it is important that the cloth be washed thoroughly before use.
- Clothes may sometimes get stained during menstruation. This is not a serious problem. There is no need to feel shame. To maintain hygiene, students should change out of the stained clothes as soon as they get a chance. Undergarments should be washed well and dried thoroughly in direct sunlight to ensure that they are germ-free. This can reduce the risk of infection.
- Common food-related restrictions during menstruation need critical examination. In Chapter 3 ('The Mystery of Food') of the Grade V EVS textbook (NCERT, 2025), students read about the role of microbes in food spoilage.[4] Students were encouraged to draw on this understanding to question whether foods like pickles or *badi* spoil because of menstruation, or due to factors such as poor handling or storage.
- Menstruating girls need not stop playing sports unless they experience discomfort or pain due to the physical activity.
- If menstruating girls experience severe menstrual pain that disrupts daily activities, they need medical attention. Under the Rashtriya Kishor Swasthya Karyakram (National Adolescent Health Programme), all 11–19 year olds can access free tests and treatment at government hospitals. This service is available in the government hospital nearest our school. Students were informed that their Aadhaar card is required as proof of age.

Highlighting the pain, discomfort, and social restrictions many girls and women experience during menstruation, I emphasized the need for boys to be sensitive in how they relate to menstruating girls and women. We also discussed some ways in which boys could support menstruating classmates and family members without causing them discomfort or embarrassment.

Open discussion to understand emotional changes

I began this exercise by using the board to list the emotional changes that the students had shared in their responses to the questionnaire:

(a) Feeling more comfortable sharing problems with friends than with parents.
(b) Becoming easily irritated by minor issues.
(c) Wanting to talk more than usual.
(d) Wanting to make new friends.
(e) Experiencing romantic attraction (like falling in love with someone, then cheating on them with someone else).
(f) Taking minor issues very seriously.
(g) Feeling more stressed than usual.
(h) Wanting to hide oneself, such as by keeping the body covered.
(i) Becoming more aware of and sensitive to others' problems.

Through open discussion, I sought to prepare students for these emotional changes by raising the following points:

- Irritability, stress, and tension over small matters are common during adolescence and often stem from the challenge of adjusting to rapid physical and emotional changes.
- Feelings of attraction and closeness during adolescence are natural and important experiences. At the same time, this is a period when students are still learning about themselves and what they value. Giving attention to studies, friendships, interests, and personal goals during this phase can help build a strong foundation for future relationships.
- When students share problems only with friends—who are of similar age and experience—do they find meaningful solutions? If not, whom else might they approach for guidance?

- Adolescent girls may feel socially inhibited as they experience physical changes, particularly in the early stages of adolescence. These feelings are natural and often temporary, as the body gradually adjusts and the pace of change slows over time. It may be important for girls to keep this in mind and not let their hesitation limit their confidence or hinder the development of their personality.

'Anonymous' question box to share social challenges

One of the most challenging aspects of adolescence is adjusting to social changes. To explore this, I distributed blank slips of paper and invited students to write down any questions or concerns related to this aspect of their lives. I assured them that their responses would remain completely anonymous, allowing them to share issues they might otherwise feel hesitant or shy to speak about. At the end of the class, students put their slips into a box provided for this purpose (see **Fig. 1**). Here are some examples of the concerns that the students shared:

- *"Once, while walking on the road, I was teased by some boys. I did not feel comfortable telling my friend. Should I tell my mother?"*
- *"Since I turned 11, I have been stopped from playing sports. Why?"*
- *"When I turned 13, there were some restrictions on my going out. Now that I am 14, I am not allowed to go out at all. But my brother is not stopped from going out. Why does this happen to girls? Is this right or wrong?"*
- *"I once had to return home alone at night after watching a Ramlila performance. I felt very scared when I saw a group of boys on the way."*
- *"If a boy stares at me, teases me, and calls me strange names to harass me, what should I do?"*
- *"If I have made a very bad mistake, how should I correct it?"*
- *"Should we share what is on our minds with others or keep it to ourselves?"*
- *"I am afraid that if I share my problem with a friend, they may tell someone else."*
- *"A boy I know told his friends that a girl, who lived in a house they had just walked past, was his girlfriend. I felt that he was defaming that girl."*
- *"I used to believe that ghosts exist. Is this true?"*
- *"One of my friends says that everyone gets bad thoughts during adolescence. Is this right or wrong?"*
- *"Everyone says that education is not useful for girls. They say that girls should be taught to manage the house, and boys should be taught to work outside. Why are such decisions made?"*
- *"While returning home from school, two boys from school started harassing my friend and me. I told my friend, "Come, let us run away from here." We ran as fast as we could. Later, my friend and I decided that we would complain about the boys to a teacher in our school. Sir listened to our complaint and scolded the boys. What should we do if we run into those boys again?"*

I read each slip and framed responses with care. In the next class, I shared and discussed these concerns with students. Here are some of my responses:

- If someone misbehaves with you on the road or elsewhere, **protest loudly**. If your friends are with you, protest together. Loud voices attract attention and discourage the person harassing you, making them less likely to repeat such behaviour. It is also important that you tell your parents about such incidents.
- If you have made a mistake that you can correct on your own, make the effort to do so. If it is beyond your capacity, speak to a teacher or your parents.
- In many families, girls are not allowed to go out in the evenings, often because parents and elders are concerned about their safety. While this can feel restrictive, it is important for girls to gradually build physical and mental strength so that family members develop greater confidence in their ability to take care of themselves. One way to do this is by participating in the 'Rani Laxmi Bai Self-Defence Training Programme' conducted in schools. This programme is designed to equip adolescent girls with simple skills and techniques to handle common situations related to self-protection.

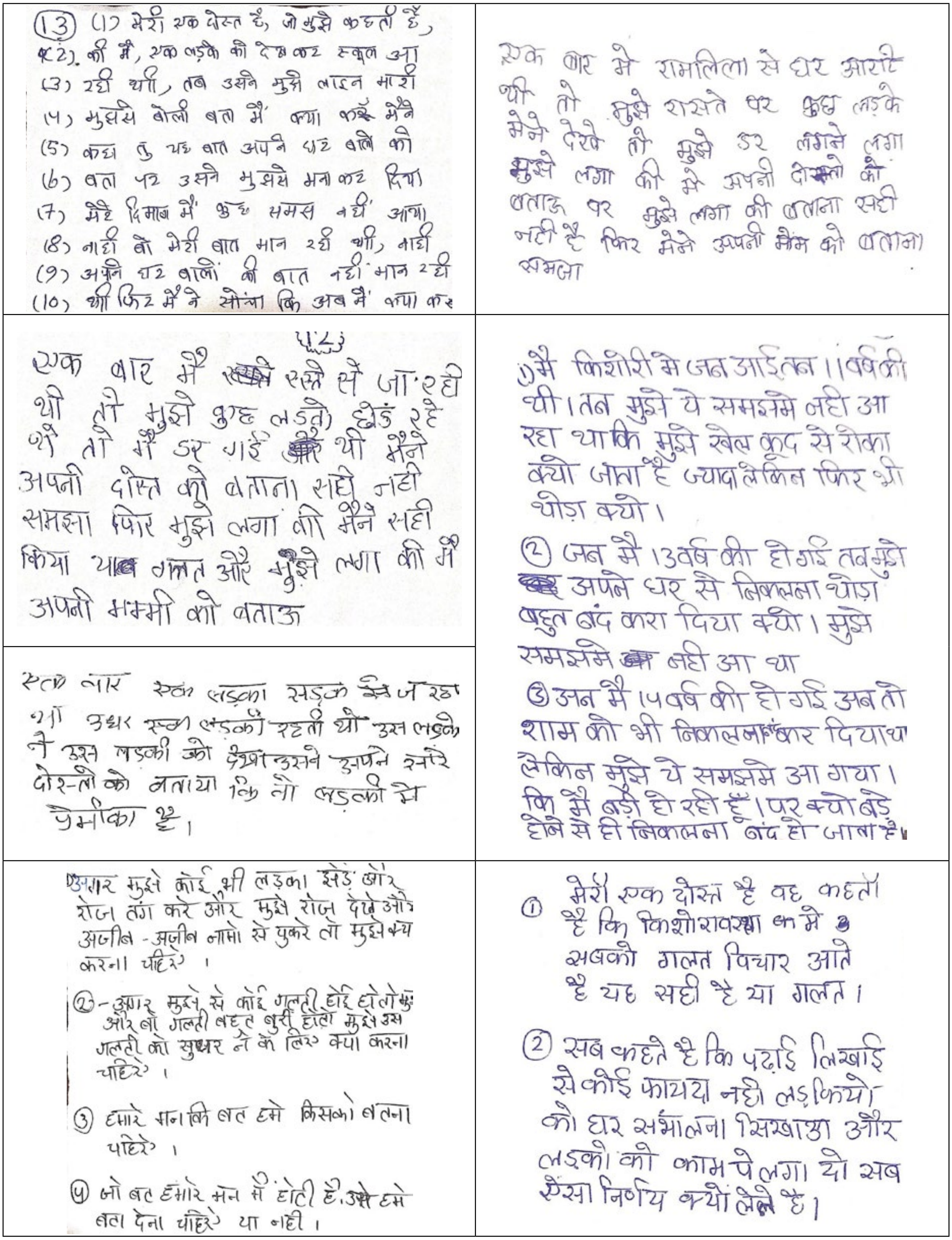


Fig. 1. Examples of some social challenges during adolescence. These are some of the slips of paper students dropped into the Anonymous Question Box.

Fig. 2. Participation in housework. This can help adolescent boys and girls prepare for the responsibilities of adulthood.

Credits: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Nov 2025). License: CC BY-NC-ND.

- Studies are important, but so is participation in household work. Both boys and girls should share responsibilities at home (see **Fig. 2**). Engaging in housework helps students prepare for future responsibilities and provides opportunities for parents and other family members to guide them in becoming responsible and caring family members and citizens.
- Along with schoolwork, some students may have the chance to learn skills that could help them earn a livelihood in the future (see **Fig. 3**). These opportunities should be taken seriously, as they can provide practical experience and open doors for future independence. The National Education Policy (NEP) 2020 also highlights the importance of vocational education, encouraging students to explore and develop such skills alongside their regular studies.[5]

Parting thoughts

The questions, opinions, and concerns shared by my adolescent students reminded me of some of the confusion and conflict I experienced as an adolescent. The physical and emotional changes students go through, along with social attitudes

Fig. 3. Engaging in vocational education. Encouraging adolescents to explore skills outside schoolwork can help them gain practical experience of a potential future livelihood.

Credits: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

Box 3. Curricular connections:

These activities and the supporting discussion can help meet the following:

A) **Curricular goal for middle-stage science:** CG-4: [The student] understands the components of health, hygiene, and well-being. Specifically, it can help students develop the competency (C-4.3) to: *"Describe biological changes (growth, hormonal) during adolescence, and measures to ensure overall well-being."*[6]

B) **Learning outcomes (LO) for Grade VIII science**:

- [The student] enumerates different variations that take place in the body at puberty to explain the effect of adolescence on the changing human body.
- [The student] defines adolescence and adolescent age in order to explain changes at puberty.
- [The student] enumerates different variations that take place in the body at puberty to explain the effect of adolescence on the changing human body.
- [The student] applies learning of scientific concepts in daily life /real-life situations in order to solve problems /give solutions /take preventive measures /etc. For example, challenge myths and taboos regarding adolescence, etc.[7]

toward them, can strongly influence their personality. Some adolescent boys and girls succeed in meeting these changes and overcome social challenges through their confidence in themselves, the ability to make good decisions, and the support of the people (family members and teachers) around them. Others, however, struggle to find their way. For this reason, I believe it is essential for teachers to provide guidance to students during this period of rapid physical, emotional, and social change.

My classroom experience reaffirmed the importance of including a chapter on adolescence in the middle-stage science curriculum (see **Box 3**).[6, 7] It also highlighted the need for teachers to engage with this chapter thoughtfully and thoroughly.

Working with this chapter requires discussing human reproduction and the physical changes that occur during adolescence—topics that are often sensitive or surrounded by social taboos. To address them openly and critically, teachers must set aside any personal shame or hesitation and approach these discussions with confidence and care.

To ensure open dialogue, it is also important for teachers to gain the trust and confidence of their students. Providing opportunities to share any troubling questions and concerns anonymously can allow students to express themselves freely. Responding to their concerns with sensitivity and respect can help students feel safe and supported in navigating this period of their growth.

Key takeaways

- The Grade VII curriculum introduces students to adolescence as a stage of growth marked by physical, biological, and emotional changes.
- Encouraging students to record and discuss the physical changes they observe in themselves can help them understand that these are natural and common to this stage.
- Discussing the menstrual experiences of adolescent girls promotes awareness of hygiene and nutrition, helps boys respond sensitively to menstruating peers or family members, and encourages critical reflection on social taboos.
- Exploring emotional changes enables students to recognize the value of seeking guidance from supportive adults.
- Addressing social challenges helps adolescents consider ways to protect themselves, contribute to household responsibilities, and take advantage of opportunities to learn vocational skills.
- Providing opportunities for students to share concerns anonymously in a safe and supportive classroom fosters open, respectful discussion.

Acknowledgements:

The i wonder... team thanks Shiv Pandey from Azim Premji Foundation for encouraging the author to record this experience, for recommending her draft to us, and for his support in publishing it. We also thank Rajesh Utsahi from Azim Premji University for his support in translating the original draft (in Hindi) into English.

Notes:

(a) Credits for the image (Adolescent hygiene) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

(b) This article includes three detachable classroom resources: **Activity Sheet: Common Beliefs about Periods—Myths or Facts?**, **Student Handout I: Myths and Facts about Periods**, and **Student Handout II: Learning About Periods: A Guide for Boys.**

(c) Teachers may find two books on Adolescence published by Ekalavya Pitara useful in their classroom instruction: My Body My Life (URL: https://eklavyapitara.in/products/my-body-my-life?) and *Beta Kare Sawal* (URL: https://eklavyapitara.in/products/beta-kare-sawal?). They may also find Dhanya K's article 'Teaching Human Reproduction' in the June 2022 issue of i wonder... (URL: https://publications.azimpremjiuniversity.edu.in/4148/) useful.

References:

1. National Council of Educational Research and Training (2025). 'Chapter 6: Adolescence: A Stage of Growth and Change'. Curiosity, Textbook of Science for Grade VII: 73–88. URL: https://ncert.nic.in/textbook/pdf/gecu106.pdf.
2. Fiveable Content Team (2024). '1.1 Defining adolescence and its stages—Adolescent Development'. Fiveable. Last updated in Sep 2025. URL: https://fiveable.me/adolescent-development/unit-1/defining-adolescence-stages/study-guide/JNmXpy8kKnLRp1ka. Accessed on: Nov 10, 2025.
3. Sampark Didi (2024). 'किशोरावस्था एवं यौवनारम्भ'. YouTube. URL: https://www.youtube.com/watch?v=nu1igmJ81l8.
4. National Council of Educational Research and Training (2025). 'Chapter 3: The Mystery of Food'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade V: 40–54. URL: https://ncert.nic.in/textbook.php?eeev1=3-10.
5. Ministry of Human Resource and Development, Government of India (2020). 'National Education Policy 2020'. Ministry of Education. URL: https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf.
6. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
7. Central Board of Secondary Education (2020). 'Teachers' Resource for Achieving Learning Outcomes, Classes 1 to 10'. URL: https://cbseacademic.nic.in/web_material/Manuals/TeachersResource_LODoc.pdf.

Anita Rawat works as the Headmistress of Government Upper Primary School Chaukoni, Rudrapur, Udham Singh Nagar, Uttarakhand. She holds postgraduate degrees in English and Education and has been teaching for almost 27 years. Anita is an innovative science teacher. She enjoys teaching science in ways that help students develop a strong interest in the subject and connect it to social issues. She can be contacted at: anitarawat7988@gmail.com.

DID YOU KNOW?

GROWING UP IS NOT JUST A HUMAN THING

Many children think adolescence is only a 'human problem.' However, many other mammals also go through a developmental phase between early youth and adulthood, marked by physical growth and changes in behaviour. Although this phase is not identical across species, young mammals often show increasing independence from caregivers and greater interaction with peers. For example, young calves and goats that previously stayed close to their mothers gradually spend more time feeding on their own and interacting physically with other young animals. In goats, behaviours such as pushing or butting are commonly observed during this stage and contribute to physical development and the establishment of social relationships. Young dogs that earlier responded consistently to training may show increased restlessness or variable responses during periods of rapid growth and hormonal change. Young cats may begin to range farther from familiar areas, climb higher structures, and have more frequent encounters with other animals as their mobility, strength, and exploratory behaviour increase. In several primate species, young monkeys spend more time with peers and engage in rough play, such as chasing and wrestling, while still relying on adults for protection. In many mammals, this stage of development is associated with continued growth, learning through experience, increasing independence, and changes in social behaviour that differ from those seen in early childhood or full adulthood.

Question for students: Think of a young animal you see in your neighbourhood (cow, dog, goat, cat, or monkey). As it grows, what changes do you notice in its behaviour, level of independence, or interactions with other animals? How might these changes affect the animal's ability to live as an adult?

Azim Premji University

ACTIVITY SHEET: COMMON BELIEFS ABOUT PERIODS—MYTHS OR FACTS?

Ground rules (read aloud):

- Use respectful language.
- Questions are welcome; teasing is not.
- It is okay to keep some things private. Share only what you feel comfortable sharing.

What to do:

In the table below are some things about periods that people often say. Pair up with a classmate and take turns reading each statement aloud. Discuss if it is a myth or a fact, and explain why.

S. No.	What you may hear about periods	Myth/Fact	Why?
1.	Periods are a sign of illness.		
2.	Using pads/cloth causes illness.		
3.	Period pain means something is seriously wrong.		
4.	Period pains must be silently tolerated.		
5.	All girls start menstruating at the same age.		
6.	Periods should always come on the same date each month.		
7.	Stress, illness, or travel can affect the timing of periods.		
8.	All girls have the same menstrual experience.		
9.	All forms of physical activity should be avoided during periods.		
10.	A girl should hide her periods from everyone.		
11.	Talking about periods is shameful.		
12.	Talking about periods encourages 'bad behaviour'.		
13.	Period blood is 'dirty' or 'impure'.		
14.	Girls should sleep in a different room during periods.		
15.	Girls should not touch food or cook during periods.		

S. No.	What you may hear about periods	Myth/Fact	Why?
16.	Girls should not pray or enter sacred spaces (like temples) during periods.		
17.	Plants die if girls having their periods touch or go near them.		
18.	Boys do not need to learn about menstruation.		
19.	Buying menstrual products is shameful.		

Think about and discuss:

Q1. Which of these statements surprised you most? Which ones were you most familiar with?

Q2. How did you decide if a statement was a myth or fact? What role did science play in this?

Q3. Do you have any questions about periods that would help you decide if these statements are myths or facts. Record them here.

Q4. How do you think period-related myths are created and spread?

Q5. How do you think period-related myths can affect health, school participation, and confidence?

Q6. Can you think of one period-related myth that you can challenge with evidence? How would you do this?

Q7. Can you think of one period-related myth that might be harder to challenge? Why?

Q8. Have you heard anything about periods that is not in the first table in this sheet? Record it in the table below.

S. No.	What I have heard about periods	Myth/Fact	Why?

Q9. After you finish this activity, read **Student Handout I** and **II**. Did you learn something new or surprising?

i wonder... Rediscovering school science

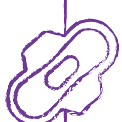
Contributed by:

Chitra Ravi, who works at Azim Premji University, Bengaluru. She can be contacted at: chitra.ravi@apu.edu.in.

Anita Rawat, who works as the Headmistress of Government Upper Primary School Chaukoni, Rudrapur, Udham Singh Nagar, Uttarakhand. She can be contacted at: anitarawat7988@gmail.com.

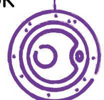
STUDENT HANDOUT I: MYTHS AND FACTS ABOUT PERIODS

The table below lists some common beliefs about periods. You have already seen these in Activity Sheet: Periods—Myth or Fact? You may also hear some of them from friends or family members.

S. No.	What you may hear about periods	Myth/ Fact	Why?
1.	Periods are a sign of illness.	Myth	Girls may feel unwell during periods. But this does not make menstruation an illness. It is a **normal** part of growing up. This biological process shows that the body is **healthy** and the reproductive system is working as it should.
2.	Using pads/cloth causes illness. 	Myth	**Illness is mostly caused by lack of hygiene**, not the type of menstrual product that girls use. Maintaining good hygiene during periods is important for comfort and health. Pads and cloth are generally safe to use if clean and changed regularly. Cloth needs to be washed well and properly dried in the sun. If menstrual products cause itching, redness, or rashes, then shifting to ones made from unscented and unbleached cotton may be helpful.
3.	Period pain means something is seriously wrong.	Myth	Not usually. **Mild to moderate pain is common, especially in the early years**. However, it is important to consult a doctor if the pain is severe, interferes with everyday activities (like going to school), lasts for longer than two days, or is accompanied by other symptoms (like heavy bleeding).
4.	Period pains must be silently tolerated.	Myth	Many girls may be led to believe that menstrual pain and/or discomfort needs to be quietly tolerated. But **girls should feel comfortable asking for time to rest and for support**. When the pain or discomfort is severe, they should also feel comfortable seeking medical help.
5.	All girls start menstruating at the same age.	Myth	Most girls begin menstruating between 9 and 15 years. Typically, girls start menstruating ~ two years after their breasts start developing. But **each person's body develops at its own pace**. Starting earlier or later is usually normal. A doctor's advice is helpful if a girl: (a) Starts menstruating before age 8 or has not started menstruating by age 15–16, or (b) Has not shown other signs of puberty (such as breast development or the appearance of underarm and pubic hair) by age 13–14. This does **not** always mean something is 'wrong'—doctors can help understand what is happening, and offer reassurance and guidance.

S. No.	What you may hear about periods	Myth/ Fact	Why?
6.	Periods should always come on the same date each month.	Myth	Menstrual cycles are tracked in terms of days, not calendar dates. A typical cycle is 28 days. But this length can **vary between 21-35 days.** It is not uncommon for periods to be early, late, or irregular, especially in the first few years after a girl begins menstruating.
7.	Stress, illness, or travel can affect the timing of periods.	Fact	**Stress, sickness, exams, travel, and changes in diet, sleep, or routine can affect** hormone levels in the body. This can cause changes in flow (heavier or lighter) and/ or the length of the cycle (periods may be delayed, come earlier, or be skipped).
8.	All girls have the same menstrual experience.	Myth	Every girl's menstrual experience is unique. For example, the length of the cycle (21-35 days), duration of bleeding (2-7 days), the amount of flow, the severity of pain, and the intensity of mood swings can differ from person to person. There is **no single 'normal'** experience.
9.	All forms of physical activity should be avoided during periods.	Myth	As long as a girl feels physically comfortable, she need not stop playing, exercising, or attending school during periods. Light activity might, sometimes, reduce cramps and discomfort. Activity that requires **pushing through severe pain or discomfort is to be avoided.** It is also important for girls to know that it is okay to rest when they feel tired or unwell.
10.	A girl should hide her periods from everyone.	Myth	Talking about periods should always be a choice. No one should be forced to share personal information about it with others. At the same time, it is **important that girls feel safe and supported to talk to a trusted adult** (such as a parent, teacher, or health worker) whenever they have questions, worries, or need help.
11.	Talking about periods is shameful. 	Myth	Talking about **periods is neither inappropriate nor shameful.** Girls do not feel shame because of menstruation itself, but because of the silence and misinformation around it. When periods are not discussed openly at home or school, girls may feel it is wrong or embarrassing to talk about them. Restrictions placed on them during periods can also make this healthy body process seem like a problem. It is important for girls to have spaces where they can be sure that they will not be shamed for speaking about periods.
12.	Talking about periods encourages 'bad behaviour'.	Myth	Silence and misinformation around periods can cause problems. **Open discussion and correct information can reduce shame, fear, and confusion**. It can also build respect and empathy.
13.	Period blood is 'dirty' or 'impure'.	Myth	These ideas of impurity come from cultural beliefs, not from science. Menstrual blood is a mix of blood, tissue, mucus, and some secretions from the body. It is **not dirty, spoiled, or toxic**.

S. No.	What you may hear about periods	Myth/ Fact	Why?
14.	Girls should sleep in a separate room from others during periods.	Myth	Periods is a normal body process; not an infection. It is **not contagious**. Staying or sleeping in the same room as other people during periods causes no harm to anyone.
15.	Girls should not touch food or cook during periods.	Myth	This view comes from cultural beliefs, not science. Food does not spoil because the person handling or cooking it is menstruating. It **becomes spoiled or unsafe to eat due to poor hygiene** (like contact with unclean hands, utensils, or surroundings).
16.	Girls should not pray or enter sacred spaces (like temples) during periods.	Myth	This is a social custom, not science. Today, many communities are also beginning to recognise that these are cultural beliefs, not religious instructions. Periods are a natural body process. They **do not make a girl impure or unclean**.
17.	Plants die if girls having their periods touch or go near them.	Myth	Many girls and women across the world work with plants in fields and gardens every day. **Periods do not cause girls or women to release substances that are toxic to plants.** Plants wilt or die due to factors like disease, or the lack of water, sunlight, and soil nutrients.
18.	Boys do not need to learn about menstruation.	Myth	Menstruation is part of how the human body works. Learning about it is as important as learning about digestion or breathing. When boys do not understand this process, they may feel confused or repeat myths they hear. Sharing correct information with boys can help prevent the spread of false ideas such as periods being 'dirty' or 'shameful'. Boys who understand this process and the difficulties menstruating girls and women experience, are more likely to avoid teasing or making hurtful comments. They are also **more likely to be supportive and considerate toward menstruating classmates and family members**.
19.	Buying menstrual products is shameful.	Myth	Buying menstrual products is **like buying any other product (like soap or toothpaste) for maintaining personal hygiene**.



i wonder... Rediscovering school science

Contributed by:

Chitra Ravi, who works at Azim Premji University, Bengaluru. She can be contacted at: chitra.ravi@apu.edu.in.

Science in Action

STUDENT HANDOUT II: LEARNING ABOUT PERIODS: A GUIDE FOR BOYS

"No boys or men I know talk about periods. Why should I learn about them?"

Periods (menstruation) affect mothers, sisters, friends, and classmates. Learning about it can help you:

- Understand that periods is a natural body process.
- Avoid believing or spreading myths and wrong ideas about periods.
- Break down harmful attitudes about periods and help others understand and accept it.
- Understand what girls and women in your family and school experience each month.
- Be of help to girls and women during periods instead of feeling awkward or making fun of them.

"I hear many unscientific beliefs about menstruation. What do I do?"

Many communities have strong beliefs about menstruation that may not be true. If you hear statements like *"menstruating women are impure"* or *"they should not touch food or plants,"* remember that menstruation is a biological process, not a sign of impurity.

- Try to learn scientifically correct information about periods.
- Quietly question such ideas by asking, *"Is there a scientific reason for this?"*
- Share correct information, without arguing or insulting others.
- Accept that some people may need time to change their views.

"My family does not talk about periods. How can I learn about it?"

Talking about periods is important. Menstruation is a sign of good health, not something dirty or shameful. But it can be a sensitive topic and it is normal to feel awkward at first. Here are some ways to begin:

- Choose a quiet and private time to talk.
- Explain why you want to learn. You could say, *"I want to understand what you go through so that I can be helpful."*
- Ask open-ended questions to encourage family members to share their experiences and feelings.
- Listen carefully without laughing or making judgmental comments.
- Accept that some family members may not want to talk about certain parts of their period experience. Some things are private and you do not need to know everything.

- Let your family members know that you are ready to help in any way you can.

"I am not old enough to do much. How can I help menstruating family members having periods?"

Support does not always require big actions. Small, caring steps can make a big difference. For example, you can:

- Listen and offer comfort when someone wants to talk.
- Be patient if a family member feels tired, unwell, or irritable, and give them space to rest.
- Help with household work such as cooking, cleaning, or caring for younger siblings.
- Fetch water, groceries, or medicines when needed.
- Buy sanitary pads or other menstrual products if asked to do so.

"Boys are not usually seen buying sanitary pads. Would it not be odd for me to buy them?"

It is okay to feel shy about buying sanitary pads or menstrual products. But there is nothing wrong or funny about it. Focus on the fact that you are helping someone you care about. You can make it easier by:

- Keeping in mind that buying pads is just like buying soap, toothpaste, or medicine.
- Walking into the shop calmly and asking clearly for what is needed. You could simply say, "*One packet of sanitary pads, please,*" or share the product name if you know it.
- Reminding yourself that shopkeepers sell these products every day. You don't need to explain yourself. You are not doing anything wrong or embarrassing.
- Taking a friend along. Supporting each other can make it easier the first time.
- Thinking about the positive role you are playing in reducing shame and supporting someone you care about.

"Some boys tease or make jokes about periods. What should I do?"

Periods are not dirty or shameful, and girls cannot control when they start or stop. Teasing, laughing, or joking about periods can hurt classmates and make them feel embarrassed, ashamed, or unsafe. It can also encourage harmful attitudes and social taboos about periods. Even when you are not the one teasing, staying silent or laughing along can encourage bullying. You can help by:

- Not spreading rumours or jokes about periods.
- Changing the topic or walking away if someone starts joking about periods.
- Not teasing a classmate if she stains her clothes or feels unwell.
- Not joining in if someone else is teasing a girl. If you feel safe to do so, calmly say, for example, *"That is not right. Leave her alone."*

"I do not speak much to the girls in my class. Can I still support them during their periods?"

Support does not always require words. You can help build a classroom culture where periods are treated as normal; not embarrassing. Remember, respect and sensitivity make school safer for everyone. Here are some things you can do:

- Do not use periods as a reason to insult, blame, or exclude someone.
- Do not ask personal questions or point attention to someone's discomfort. If a classmate looks uncomfortable or worried, give her space.
- Do not whisper, point, or spread rumours if you notice stains on someone's clothes.
- Cooperate, without making jokes or comments, if a teacher asks for help, for example, in fetching water or calling a classmate.

Contributed by:

Chitra Ravi, who works at Azim Premji University, Bengaluru. She can be contacted at: chitra.ravi@apu.edu.in.

Srikanth KS, who is an independent research consultant. His primary area of interest is in host-pathogen interactions. He can be contacted at: sriikis@gmail.com.

WHY INTRODUCE STUDENTS TO BIRDWATCHING?

ADITHI MURALIDHAR & ANAND KRISHNAN

Children can observe neighbourhood birds with the naked eye in schoolyards, fields, or along village paths. How can simple birdwatching activities build their scientific thinking and ecological understanding?

The preparatory-stage environmental studies (EVS) and middle-stage science textbooks include many references to birds and their role in our lives. They also include ideas for simple activities that require students to observe neighbourhood birds and document their observations (see **Table I**).[1-4] But birds are some of the most well-documented animals on the planet. So what can our students learn from studying them?

Developing science skills

Birdwatching is a simple way of giving students practical experience of the process of science (see **Box 1**).[5] Students learn to make detailed observations, record data meticulously, write scientific descriptions, and draw scientifically valid inferences. Since birds are found almost everywhere—including gardens and schoolyards—they are ideal subjects for such explorations.

For students in the preparatory and middle stages, the most important of these skills is observation. One of the main reasons to have students watch neighbourhood birds is to help them develop and refine their observational skills.[6] It is worth noting

S. No.	Activity idea	Textbook chapter
1	*"Close your eyes and try to listen to the sounds of birds. Do you hear any bird sounds? Can you see which birds are making these sounds? Cup your ears with your hands... and point your face towards the direction of the bird sound. Can you hear the sound more clearly? Recall the bird sounds you have listened to. Try to produce the sounds that different birds make. Now, try to write down... the sound of any birds you have heard (name of the bird, sound made). If you do not hear any sounds of birds, what do you think is the reason? Do you hear more bird sounds: (a) In the early morning? (b) In the afternoon? (c) In the evening?"*	Chapter 5 ('Plants and Animals Live Together') of the Grade III EVS textbook (NCERT, 2025-2026)
2	*"Take different food items like (a) grains, (b) berries, (c) nuts, and (d) pieces of fruit, etc., on a plate. Try to pick these food items using a spoon, a toothpick, or a pair of sticks... [Record the] appropriate tool(s) for picking each of these food items. It is interesting to know that birds have beaks and claws, which help them in eating and other activities. An eagle has a sharp, curved beak and sharp claws to catch its prey, while a sunbird has a long beak to drink nectar from flowers. We can guess the eating habits of a bird by observing its beak and claws."*	Chapter 3 ('Nature Trail') of the Grade IV EVS textbook (NCERT, 2025)
3	*"Make a poster of 5 birds that visit your place in winter. Try to find out where they come from. Using a string, trace the journey on a globe showing the paths rosy starlings take (Russia/Mongolia → India). Imagine you are a bird traveling the world. Write a short postcard or note about what you see and what helps you on your journey (wind, ocean currents, warm weather). Share it with your classmates."*	Chapter 10 ('Earth—Our Shared Home') of the Grade V EVS textbook (NCERT, 2025)
4	*"What would happen if the habitat of a plant or an animal is damaged? What would happen if a goat does not get grass to eat? Can a fish survive without water? Check with your parents, grandparents, and neighbors to know about the plants, birds, insects, or any other animal they used to see frequently in their childhood, but do not see as often now. These changes often happen when habitats are damaged. The damage to the habitats of plants and animals, results in loss of their homes, food, and other resources. This leads to the loss of biodiversity."*	Chapter 2 ('Diversity in the Living World') of the Grade VI science textbook (NCERT, Reprint 2025-2026)

Table I. Birds in the school curriculum. Here are some examples of activity ideas around birds from the preparatory-stage EVS and middle-stage science textbooks.[1-4]

that many fields of science, such as natural history and astronomy, have historically depended on long-term, systematic, and meticulous observations of the natural world. More specifically, research questions in fields like ethology continue to be shaped by observations of animals in their natural settings.

To observe birds effectively, students need to pay close attention to minute details and be perceptive about the complex environments birds inhabit (see **Box 2**).[7, 8] Teachers can support this by asking questions such as: *Do birds of the same species look different? How do they differ from each other? Can you distinguish their songs or calls? How many birds did you see? Were they at different heights or in different trees? What might these observations mean?*

Appreciation of diversity

Class discussions about the different birds students observe can help foster an awareness of the diversity of living beings. Teachers can support this by pointing out how even a small group of birds can show extraordinary variety in the shapes, sizes, and colours of individual features, such as their beaks. Remarkably, the diversity of forms that bird beaks show is achieved using only bone and keratin (the same material as our fingernails)! Teachers can also highlight the variety of functions that beaks serve: probing, crushing, catching insects, boring into wood, and more. For example, in Chapter 9 ('Staying Happy and Healthy') of the Grade III EVS textbook (NCERT, 2025-2026), students read how birds use *"their beaks to clean their feathers."*[9] Similarly, in Chapter 8 ('Clothes—How Things are

Box 1. Curricular connections:

Discussions and activities around birdwatching can help teachers meet the following curricular goals for:

A) Preparatory-stage EVS:

- CG-1: [The student] explores and engages with the natural and socio-cultural environment in their surroundings. Specifically, it can help students develop the competency (C-1.1) to: *"Observe and identify the natural (insects, plants, **birds**, animals, geographical features, ...natural resources) and social (houses, relationships) components in their immediate environment."*
- CG-4: [The student] develops sensitivity towards the social and natural environment. Specifically, it can help students develop the competency to:
  - (C-4.1): *"Observe and describe diversity among plants, **birds**, and animals in their immediate environment (shape, sounds, food habits, growth, habitat),"*
  - (C-4.5): *"Identify needs of plants, **birds**, and animals, and how they can be supported (water, soil, food, care)."*
- CG-6: [The student] uses data and information from various sources to investigate questions related to their immediate environment. Specifically, it can help students develop the competency to:
  - (C-6.1): *"Perform simple inquiry related to specific questions independently or in groups,"*
  - (C-6.2): *"Present observations and findings through different creative modes (drawing, diagram, poem, play, skit, oral and written expression)."*

B) Middle-stage science:

- CG-3: [The student] explores the living world in scientific terms. Specifically, it can help students develop the competency to:
  - (C-3.1): *"Describe the diversity of living things observed in the natural surroundings (insects, earthworms, snails, **birds**, mammals, reptiles, spiders, diverse plants, and fungi), including at a smaller scale (microscopic organisms),"*
  - (C-3.3): *"Analyse patterns of relationships between living organisms and their environments in terms of dependence on and response to each other."*
- CG-7: [The student] communicates questions, observations, and conclusions related to science. Specifically, it can help students develop the competency (C-7.1) to: *"Use scientific vocabulary to communicate science accurately in oral and written form, and through visual representation."*[5]

Made') of the Grade V EVS textbook (NCERT, 2025), students learn about the tailorbird: *"With its beak, it sews the edges of a big leaf together using plant fibres or spider silk. It pokes holes along the edge of the leaf and pulls the thread through its beak, like a tailor sewing cloth, to make a soft and safe nest to lay eggs and raise its babies."*[10]

Using observable examples helps teachers illustrate the many survival mechanisms birds have evolved over millions of years. Teachers can also show how these adaptations have inspired human inventions and innovations—and may continue to do so. For instance, Japanese engineers designing the Shinkansen bullet train initially faced complaints about the sonic boom produced as the train exited tunnels. Eiji Nakatsu, one of the engineers and an avid birdwatcher, noticed how quietly a kingfisher dives beak-first into water (see **Fig. 1**). Inspired, he redesigned the train's nose to mimic the bird's conical beak, resulting in a quieter, faster, and more energy-efficient train.[11, 12]

Recognising the ecological role of birds

Students often hear that birds are pests or eat crops. Such beliefs can be explored through discussion prompts, like those in Chapter 6 ('Living in Harmony') of the Grade III EVS textbook (NCERT, 2025-2026): *"Have students spotted any birds living in or around their house? Are there uninvited birds? Why do they come? How do you feel about their presence? Which do you like, and what do you do when you do not?"*[13]

Birdwatching helps students appreciate birds as valuable members of many habitats. Many birds maintain forest ecosystems by eating fruits and dispersing seeds.[14] Some, such as sunbirds, leafbirds, and white-eyes, assist in pollination and support farmers by spreading crops.[15, 16] Others act as biological pest controllers, eating harmful

Box 2. Questions that teachers frequently ask:

1) What if a student asks me the name of a bird I do not know? It is perfectly fine not to know the name of a bird. Invite the student to describe the bird in detail—its size, shape, colour, beak, and any behaviours they observed—and record these observations. If you know the bird's name in any language (local, regional, or otherwise), share it. If you do not, explain that India is home to more than a thousand bird species, and it is difficult for anyone to know all their names. Point students to books that can help with identification, and suggest that you and the student look it up together. If needed, you could also approach a local bird expert.

2) Is there a way to 'teach' students to observe more carefully? Observation skills develop gradually through practice. You can support students by preparing them for their first birdwatching experience with simple, engaging activities that focus on observing and describing bird features (see the **Teacher's Guide**). You could also conduct a trial birdwatching exercise in which students quietly observe a bird from the classroom window or school grounds for at least five minutes. Ask them to record their observations in as much detail as possible. Individual reflection followed by group discussion (see the **Activity Sheet**) allows students to refine and deepen their observations. This trial exercise helps students learn how to make detailed observations independently.

3) What if students say they cannot observe details because the bird is too far away? Explain that long before binoculars and telescopes were available, people made careful observations using only their naked eye by learning where and how to watch birds (see the **Student Handout**). This practice trains the eyes to become effective tools of observation. Encourage students to begin with common birds that are easier to observe. If a student chooses to observe a distant or uncommon bird, encourage them to record whatever details they can. They may need to observe the bird for longer, but even a few observations are valuable.

4) **What if students ask questions about a bird's behaviour that I cannot explain?** You could convert this into a learning opportunity. Encourage students to see whether their observations can help answer these questions. Suggest that they avoid using the Internet initially, as prior reading may bias what they notice and report. If their questions remain unanswered by observation (for example, answering 'why' questions often requires going beyond observation), and students are keen, guide them to books and other reliable sources, including the Internet. Emphasise the importance of verifying sources. You can also research alongside students or consider setting up an informal 'Ask an Expert' platform where students' questions are shared with practitioners or experts willing to attend to these queries.

5) What if students want to take photographs of the birds they observe? This is fine. But clarify that photographs should not replace drawings. Drawing helps students develop sharper observation skills. Also, not all students may have access to cameras or phones, so photographs should not be mandatory. Publicly acknowledge and encourage students who use simple tools for their work, and reinforce the idea that expensive equipment is not necessary for meaningful scientific study.

6) What if students feel their drawings are not 'beautiful'? Reassure students that the purpose of drawing is not to create beautiful images, but to record important details clearly. Any drawing that serves this purpose is valuable. Share that many naturalists often make quick, rough sketches—sometimes even simple stick figures—because they focus on capturing key features. Emphasise that more attractive drawings are not necessarily more useful, nor will they receive more marks or points.

7) Is there a way to informally assess whether students' observation skills have improved? One simple approach is to repeat the trial observation task (described in Question 2 of this box) after three to four weeks. Ask students to observe the same kind of bird from the classroom window for five minutes and record their observations. Compare these records with their earlier ones to see whether the descriptions have become richer and more detailed.

8) Can you suggest additional birdwatching activities? You could compile images of common birds—such as the Red-whiskered Bulbul, Red-vented Bulbul, Common Tailorbird, and Oriental Magpie Robin—and ask students to describe their body parts. Another activity could involve distinguishing between similar-looking species, such as the Black Drongo and Ashy Drongo. You could also show short videos of common birds in class and ask students to record their observations. These activities further strengthen observation and description skills.[7, 8]

insects and protecting crops. For example, in Chapter 10 of the Grade V EVS textbook (NCERT, 2025), students read how every winter, Rosy Starlings *"…fly thousands of kilometres from southern Russia, Mongolia, and nearby countries to India. These birds enjoy the warm weather and feed on locusts and grasshoppers, helping farmers by controlling pests."*[3]

In Chapter 12 ('How Nature Works in Harmony') of the Grade VIII science textbook (NCERT, 2025), students learn that the impacts of many human activities—pollution, deforestation, habitat loss, climate change, invasive species, and overexploitation—threaten ecosystems.[17] Excessive pesticide use, for example, poisons farm birds, causing them to disappear from their habitats. Students can be encouraged to discuss questions such as: *How can we protect birds on farms and how would this benefit people?*

Fig. 1. A pied kingfisher starting its beak-first dive. An observation of this behaviour inspired a change in design of the nose of the Shinkansen bullet train.

Credits: Mehmet Karatay, Wikimedia Commons. License: CC BY-SA 3.0 Unported Deed. URL: https://commons.wikimedia.org/wiki/File:Pied_kingfisher_started_diving.jpg.

Seeing birds as indicators of environmental change

Observing where and when birds appear can encourage students to become more curious about their local environment and factors threatening it. In Chapter 13 ('Our Home: Earth, a Unique Life-Sustaining Planet') of the Grade VIII science textbook (NCERT, 2025), students read that *"… life on Earth depends on a delicate balance of living and non-living things working together… Even small changes in global temperature, oxygen levels, or the ozone layer can put life at risk."*[18] Human actions, however, are *"disturbing this balance"* and severely impacting biodiversity.[18]

One way to understand the effects of these actions is through indicator species—specific plants or animals whose presence, absence, abundance, or health provide valuable insights into local environmental conditions. Indicator species are often common, easily recognizable, and respond strongly to particular environmental changes, often in ways detectable without specialized training or instruments.[19] Birds offer many such examples:

- **Immediate sensitivity to harmful substances:** In Chapter 11 ('Nature's Treasures') of the Grade VI science textbook (NCERT, Reprint 2025-2026), students read how coal is *"found in several parts of India,"* and is mined *"… for the production of electricity."*[20] Coal mining releases poisonous gases like methane, carbon monoxide, sulphur dioxide, and nitrogen.[21] Exposure to these gases can cause serious respiratory diseases (like asthma and bronchitis) in humans, and can even be fatal. Until the 1960s, miners in many parts of the world took caged canaries into underground mines with them (see **Fig. 2**). These small, yellow birds are highly sensitive to toxic gases. If the bird showed any signs of distress—stopping singing or falling off their perch—miners would be alerted to the presence of a toxic gas, even when the gas was

Fig. 2. A photograph (taken in 1928) of mining foreman R Thornburg holding a small cage with a canary in it. Miners used this bird as an early warning system to detect toxic gases, such as carbon monoxide, in underground mines, so they could escape in time.

Credits: George McCaa, U.S. Bureau of Mines, Wikimedia Commons. License: CC BY. URL: https://commons.wikimedia.org/wiki/File:Canary_coal_mine.jpg.

undetectable by sight or smell. The mine would be evacuated—a practice that saved countless lives.[22]

- **Declines indicating chemical pollutants:** The dramatic drop in vulture populations in India since the 1990s indicated the presence of harmful chemical pollutants in the food chain.[23, 24]. As students read in Chapter 2 ('Land, Soil, Water, Natural Vegetation and Wildlife Resources') of the Grade VIII geography textbook (NCERT, 2024-2025), scientists found that: *"Vultures in the Indian subcontinent were dying of kidney failure shortly after scavenging livestock treated with Diclofenac, a painkiller that is similar to aspirin or ibuprofen."*[25] Vultures play a vital role in keeping ecosystems clean. Their decline has been linked to an increase in stray dog populations, which feed on carcasses that vultures would otherwise consume, and to a rise in rabies cases across India.[26, 27]
- **Variations revealing ecological history:** Changes in bird characteristics can indicate the environmental history of their habitats. Chapter 2 of the Grade VI science textbook (NCERT, 2024) highlights how habitats shape the survival traits of plants and animals.[4] Darwin's finches provide a striking example: when extreme environmental changes reduced food availability, these small, sparrow-like birds evolved around 18 different beak shapes and sizes, allowing them to exploit different food sources—tough seeds, insects, cacti, and buds—across separate islands.[28] Studying this diversity offers insights into environmental change on the Galapagos Islands.

Connection with the natural world

Birdwatching can also help re-establish our fading connection with the natural world. Many philosophers and scientists have suggested the presence of an aesthetic (beauty) dimension in the way humans relate to the natural world. We are often filled with wonder by its physical beauty, and derive a sense of fulfilment and satisfaction when amidst it. Studies suggest that such experiences can benefit the health and well-being of children.[29]

Parting thoughts

Birdwatching can be an accessible and inexpensive activity for students from a range of sociocultural and natural environments. It can help them see links between birds (their presence, behaviour, and any variations they show) and their immediate environment (abiotic, biotic, natural, or artificial). It can also help students develop skills of observation, attention to detail, and documentation—all integral to the scientific process.[6]

Key takeaways

- Preparatory-stage EVS and middle-stage science textbooks offer many simple activities to encourage students to observe neighbourhood birds.
- Birdwatching provides practical experience of the scientific process, helping students develop key skills such as making detailed observations, recording data meticulously, writing scientific descriptions, and drawing valid inferences.
- Long-term observation of different birds fosters appreciation of their diversity and ecological roles, while also nurturing students' connection with the natural world.

Acknowledgements:

This article and the related classroom resources were first developed as part of the 'Rediscover, Describe, and Draw Birds' learning unit of the Vigyan Pratibha Project at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. URL: https://vigyanpratibha.in/index.php/rediscover-describe-and-draw-birds-2/. These were published as a four-part series in Teacher Plus magazine: (a) Muralidhar A & Krishnan, A (2018). 'Why study birds?' Teacher Plus, 16(7): 48–50. URL: https://teacherplus.org/2018/2018/august-2018/why-study-birds/. (b) Muralidhar, A (2018). 'Discover, Describe and Draw Birds.' Teacher Plus, 16(9): 32–35. URL: https://teacherplus.org/2018/2018/october-2018/discover-describe-and-draw-birds/. (c) Muralidhar, A (2019). 'Discover, Describe and Draw birds: Handouts and Resource List for the Activity on Observing Birds.' Teacher Plus, 17(1): 52–56. URL: https://teacherplus.org/2019/ecowatch/discover-describe-and-draw-birds-2/. (d) Muralidhar, A (2019). 'A fancy for flight'. Teacher Plus, 17(2): 52–56. URL: https://teacherplus.org/2019/ecowatch/a-fancy-for-flight/. They have also been printed as: Muralidhar, A, & Krishnan, A (2021). 'Rediscover, describe, and draw birds'. In Choksi, B, Date, G, Gupta, A, Mani, R & Subramaniam, K (Eds.), Exploring Science and Mathematics with Vigyan Pratibha Learning Units, Class 8: Teacher Version: 105-136. Mumbai: HBCSE. The version of the article published here has been restructured and modified by Chitra Ravi to include new details that connect the ideas in the original article with the preparatory-stage EVS and middle-stage science curricula. The resource versions published here have minor changes in wording and structure. The i wonder... team thanks the authors for their permission to publish these versions.

Notes:

(a) Credits for the image (School kids birdwatching at Annamalai Hills, Tamil Nadu) used in the background of the article title are: PJeganathan, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Birdwatching_in_India_JEG0901.jpg. License: CC BY-SA 4.0 International Deed.

(b) This article includes three detachable classroom resources: **Activity Sheet: Observe a Bird in your Neighbourhood**, **Student Handout: Guidelines for Birdwatching**, and **Teacher's Guide: Observe a Bird in your Neighbourhood**.

References:

1. National Council of Educational Research and Training (2025-2026). 'Chapter 5: Plants and Animals Live Together'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade III: 62-71. URL: https://ncert.nic.in/textbook.php?ceev1=5-12.
2. National Council of Educational Research and Training (2025). 'Chapter 3: Nature Trail'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade IV: 35-56. URL: https://ncert.nic.in/textbook.php?deev1=3-10.
3. National Council of Educational Research and Training (2025). 'Chapter 10: Earth—Our Shared Home'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade V: 161-182. URL: https://ncert.nic.in/textbook.php?eeev1=10-10.
4. National Council of Educational Research and Training (Reprint 2025-2026). 'Chapter 2: Diversity in the Living World'. Curiosity, Textbook of Science for Grade VI: 9-34. URL: https://ncert.nic.in/textbook.php?fecu1=2-12.
5. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
6. Dvornich, K, Petersen, D, & Clarkson, K (2011). 'Fostering outdoor observation skills: Preparing children for outdoor science and recreation'. Washington, DC: Association of Fish and Wildlife Agencies' North American Conservation Education Strategy.
7. Muralidhar, A & Krishnan, A (2023). 'Rediscover, describe, and draw birds'. Vigyan Pratibha Learning Unit. URL: https://vigyanpratibha.in/index.php/rediscover-describe-and-draw-birds-2/. Accessed on: Dec 1, 2025.

8. Muralidhar, A (2019). 'A fancy for flight'. Teacher Plus, 17(2): 52–56. URL: https://dnte.hbcse.tifr.res.in/wp-content/uploads/2020/01/2019-Am-P4-Scaling-and-FAQs-TeacherPlus.pdf. Accessed on: Dec 1, 2025.
9. National Council of Educational Research and Training (2025-2026). 'Chapter 9: Staying Happy and Healthy'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade III: 109-120. URL: https://ncert.nic.in/textbook.php?ceev1=9-12.
10. National Council of Educational Research and Training (2025). 'Chapter 8: Clothes—How Things are Made'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade V: 131-144. URL: https://ncert.nic.in/textbook.php?eeev1=8-10.
11. Birds Connect Seattle (2023). 'It's a Bird. It's a Plane.: Aviation Designs Inspired by Birds | EarthCare Northwest'. URL: https://birdsconnectsea.org/2023/09/21/its-a-bird-its-a-plane-aviation-designs-inspired-by-birds-earthcare-northwest/. Accessed on: Dec 12, 2025.
12. Baker, J (2025). 'From bullet trains to green buildings: Innovators take cue from nature through biomimicry'. The Ray C. Anderson Foundation. URL: https://www.raycandersonfoundation.org/articles/from-bullet-trains-to-green-buildings-innovators-take-cue-from-nature-through-biomimicry. Accessed on: Dec 12, 2025.
13. National Council of Educational Research and Training (2025-2026). 'Chapter 6: Living in Harmony'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade III: 72-83. URL: https://ncert.nic.in/textbook.php?ceev1=6-12.
14. McCoy, MK (2024). 'New study links birds' diets to forest health'. Conservation International. URL: https://www.conservation.org/news/new-study-links-birds-diets-to-forest-health. Accessed on: Dec 12, 2025.
15. Subramanya, S, & Radhamani, TR (1993). 'Pollination by birds and bats'. Current Science, 65(3): 201-209. URL: https://www.currentscience.ac.in/Volumes/65/03/0201.pdf.
16. Cirino, E (2016). 'What Do the Birds and the Bees Have to Do With Global Food Supply?' Audubon. URL: https://www.audubon.org/news/what-do-birds-and-bees-have-do-global-food-supply. Accessed on: Dec 12, 2025.
17. National Council of Educational Research and Training (2025). 'Chapter 12: How Nature Works in Harmony'. Curiosity, Textbook of Science for Grade VIII: 190-209. URL: https://ncert.nic.in/textbook.php?hecu1=12-13.
18. National Council of Educational Research and Training (2025). 'Chapter 13: Our Home: Earth, a Unique Life Sustaining Planet'. Curiosity, Textbook of Science for Grade VIII: 210-227. URL: https://ncert.nic.in/textbook.php?hecu1=13-13.
19. Sherwood, MA (2024). 'Indicator species'. EBSCO Knowledge Advantage. URL: https://www.ebsco.com/research-starters/science/indicator-species. Accessed on: Dec 12, 2025.
20. National Council of Educational Research and Training (Reprint 2025-2026). 'Chapter 11: Nature's Treasures'. Curiosity, Textbook of Science for Grade VI: 207-230. URL: https://ncert.nic.in/textbook.php?fecu1=11-12.
21. Chart Industries (2023). 'The Most Dangerous Gases in Mining'. URL: https://www.chartindustries.com/Articles/The-Most-Dangerous-Gases-In-Mining. Accessed on: Dec 1, 2025.
22. Bonney, A (2020). 'Canaries in the Coal Mine'. The Gale Review. URL: https://review.gale.com/2020/09/08/canaries-in-the-coal-mine/. Accessed on: Dec 1, 2025.
23. Srivastava, A (2025). 'The Status of Vultures in India: A Story of Decline and Recovery'. EcoNE. URL: https://www.econe.in/post/vulture-conservation. Accessed on: Dec 1, 2025.
24. Gopalan, R (2025). 'The Disappearing Vultures'. i wonder..., 13: 21-25. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6316/. Accessed on: Dec 1, 2025.
25. National Council of Educational Research and Training (2024-2025). 'Chapter 2: Land, Soil, Water, Natural Vegetation and Wildlife Resources'. Resources and Development, Textbook for Grade VIII for Geography: 7-21. URL: https://ncert.nic.in/textbook.php?hess4=2-5.
26. Vulture Conservation Foundation (2024). 'Vulture decline in India linked to death of 500,000 people, study suggests'. URL: https://4vultures.org/blog/vulture-decline-in-india-linked-to-death-of-500000-people-study-suggests/. Accessed on: Dec 1, 2025.
27. Markandya, A, Taylor, T, Longo, A, Murty, MN, Murty, S, & Dhavala, K (2008). 'Counting the cost of vulture decline—an appraisal of the human health and other benefits of vultures in India'. Ecol. Econ., 67: 194-204. URL: https://www.sciencedirect.com/science/article/abs/pii/S092180090800178X. Accessed on: Dec 1, 2025.
28. Cowie, G (2024). 'Icons of Evolution: Why are there so many Darwin's finches?' The Linnean Society. URL: https://www.linnean.org/news/2024/10/23/icons-of-evolution-why-are-there-so-many-darwins-finches. Accessed on: Dec 1, 2025.
29. Children & Nature Network and IUCN-CEC (2012). 'Children & Nature Worldwide: An exploration of children's experiences of the outdoors and nature with associated risks and benefits'. URL: https://static.spacecrafted.com/a60a6756a1124f3b8aa05f622e7ba46e/r/ad128d0cb61e49de836c0ab46715578d/1/d19248adc8ab4bf182a7e448fb72001b.pdf. Accessed on: Dec 12, 2025.

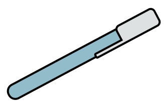
Adithi Muralidhar is a Scientific Officer at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. She runs a nature blog called 'Earthly Notes' (www.earthlynotes.com). She can be reached at: adithi@hbcse.tifr.res.in.

Anand Krishnan is an Assistant Professor at the Evolutionary and Organismal Biology Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, where he studies acoustic communication and functional anatomy in birds. He can be reached at: anandk@jncasr.ac.in.

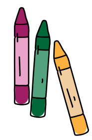
ACTIVITY SHEET: OBSERVE A BIRD IN YOUR NEIGHBOURHOOD

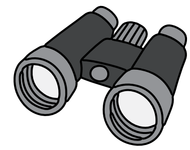
You will need:


Notebook


Pen


Pencil


Colours


A pair of binoculars would help


Camera and field guides (illustrated manuals for identifying birds) are optional

Step I: Record individual observations

Time: 10 minutes every morning, noon, and evening.
How long: For ~ four weeks. Type: Individual activity.

1) Carefully go through the section '**Ethics to keep in mind**' in the **Student Handout**. Can you think of other precautions that your classmates and you can take while observing birds? Make note of these and discuss them in class later.

2) Choose a safe place in your school or near your home where you often see birds. This place will be your 'observation point' for the next few weeks.

3) Try to spend at least 10 minutes at your observation point three times a day—in the morning, afternoon (noon), and evening. Use this time to observe the kind of bird you have chosen to study. It is possible that a bird, say a House Crow, you have been observing for a few minutes flies away. Record your observations and continue observing another crow. If you would like, you may spend more than 10 minutes observing birds.

4) Begin each observation session by recording the following details in your notebook: day, date, time, weather, and location. Also make a note about how much time you used for the observation.

5) Observe the bird patiently and quietly. Record all that you find interesting about the bird or its behaviour in as much detail as you can. You may use the terms in the section **'How to describe?'** in the **Student Handout**. You are also free to describe what you see in your own words.

6) You may use drawings, illustrations, or flowcharts to describe your observations. Your drawings do not need to be neat or beautiful. Try to draw the bird just as you see it. Label your drawing. You may colour it if you like.

7) If you have been observing a bird for a week and are still unsure how to describe what you have seen in your own words, you may use the section '**What to Observe**?' in the **Student Handout** to help you get started. But, remember, your notes should be based on what you observe over four weeks or more. They should not be copied from a friend, books, or the Internet.

Step II: Compile group observations

Time: 80-120 minutes.
When: To be done four weeks after Step I.
Type: Group activity

1) Form a group with classmates who have observed the same kind of bird as you. Share and discuss your observations with one another.

2) For each question given below, write down what each group member observed:

   a) At what time of day did you most often see the bird? At what time of day did it seem to be most active?

   b) Where did you usually see the bird—on the ground, in grass, on shrubs, or in trees?

   c) What kind of perch did the bird prefer—higher branches, lower branches, or the ground?

   d) Did the bird stay in one place for a long time, or did it keep changing its location?

   e) Did the shape or outline (silhouette) of the bird always look the same?

   f) What did you see the bird eating?

   g) Was the bird usually seen alone or with other birds? If it was seen with other birds, did it stay near birds of the same kind or of a different kind? Was the bird often seen in pairs? If yes, what kind of pairs (male-female, male-male, female-female, or with a bird of another species)?

   h) Was the bird very vocal (made many calls or sounds), or was it mostly quiet?

   i) What other things did the bird interact with? Did it interact with living beings (such as birds of its own kind, other birds, or animals) or non-living things (such as water, soil, or objects)?

   j) Which living beings (birds/animals/reptiles) did the bird seem to fear? Which ones did it not seem to fear? Did the bird fly away when human beings came close?

   k) Which behaviours (for example, searching for food, eating, preening, resting, flying, or calling) did you notice most often?

   l) Did you see any roosting places? If yes, how many birds were roosting there?

   m) Did you see any nesting sites? If yes, how many birds were nesting?

3) For each question, compare the observations made by group members. Try to identify what was similar and what was different in your observations.

4) Look for areas where your observations need to be more detailed or more precise. For example, is the House Crow only black in colour, or does it have both grey and black feathers?

5) If you feel that you have too few notes, continue your observations for another 1–2 weeks. After this, repeat Step II with your classmates.

Step III: Refine your documentation

Time: 80 minutes.

When: To be done 1–2 weeks after Step II. Type: Group activity.

1) Work on improving and organising your documentation. Along with written notes, you may use mind maps, flowcharts, flash cards, or any other visual form to present your observations. Here are some details you will need for a flash card.

Drawing/sketch of the bird	Name of the bird	
	Describe the bird	Map/location of observation
Interesting observations	Sound	
	Habitat	
	Diet	
	Other information	

2) If you noticed any unusual or interesting behaviour, write a short report about it, including clear and exact details.

Contributed by:

Adithi Muralidhar, who is a Scientific Officer at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. She runs a nature blog called 'Earthly Notes' (www.earthlynotes.com). She can be reached at: adithi@hbcse.tifr.res.in.

Life in Our Backyard

STUDENT HANDOUT: GUIDELINES FOR BIRDWATCHING

Azim Premji University

A) Ethics to keep in mind

When we look for or observe birds, it is important to behave in ways that keep birds safe and protect their surroundings. Birdwatching should never harm birds or their habitats. Here are some points to keep in mind:

- Wear muted, earthy colours (greens, browns, and greys) to blend into the surroundings. Avoid using powders, creams, perfumes, or lotions with strong smells.
- Do not enter private land without permission. Always take permission from landowners before entering farms, fields, or private property.
- Stay on existing paths, footpaths, or trails. Do not trample fields, crops, or fragile habitats. Also, be mindful of people's privacy and avoid pointing binoculars or cameras toward homes.
- Moving around a lot does not always help you see more birds. You can often see birds by standing or sitting quietly in one place and waiting patiently.
- Avoid making noise or sudden movements.
- Once you spot a bird, observe it from a distance. If the bird looks disturbed by your presence or keeps flying away, then do not follow it.
- Do not harm natural surroundings (by, for example, stamping a plant or breaking twigs/branches) just to get a better view of the bird.
- Do not use food or recorded calls to attract birds.
- Be especially careful when observing birds during their breeding season. Do not go close to nests or nesting areas. Always observe nests from a safe distance, using binoculars if possible. It is usually considered wrong to take photographs of nests and baby birds. If you do take photographs, do so only from far away. Never touch a nest, eggs, or chicks. Predators such as crows, dogs, and cats may follow people and could harm the eggs or chicks. Be careful that you do not accidentally lead these animals to nesting areas.

B) What to observe?

Begin by recording details of **who, what, when, and where** for every bird you observe (see **Table I**). You may also note other interesting details. Observe **not only the bird, but also its surroundings**.

S. No.	Aspects to observe	Examples
1.	What did the bird look like?	• What was the size of the bird? Was it bigger or smaller than your palm? Can you estimate its height or weight? • What was the most noticeable feature of the bird? Why do you think it stood out? • What colour was the bird? What colours did you see on different parts of its body? What colour were its eyes?

S. No.	Aspects to observe	Examples
		• What shape was the bird's beak? Draw the shape of the beak. What do you think the bird eats? • What shape and colour were the bird's feet? How many toes did each foot have? Draw how the toes were arranged. • Could you tell the male and female apart? How? Was one larger or more colourful than the other?
2.	What did the bird sound like?	• Did you hear the bird sing or call? If yes, how would you write the sound using English, Hindi, or Kannada words? (For example: che-che-che, caw-caw, houp-houp). • Did the bird make more than one type of call? • How would you describe the sound of the call—sweet, melodious, harsh, loud, or screechy? • Was the bird calling continuously? • Did you hear the bird calling while it was sitting, flying, or both? • Why do you think the bird was calling? Do you think it was communicating with another bird? Explain why.
3.	What did you see the bird doing?	• Was the bird sitting (perching), flying, walking, hopping, swimming, or standing on one leg? Was it sleeping? • Did the bird seem to be looking for food (foraging)? Where was it searching? Did you see the bird eating anything? If yes, what? • Did you see the bird drink water? If yes, from where? • Did you see the bird pass waste? Did this happen often? • Did the bird fluff or ruffle its feathers? Did you see it cleaning itself (preening) or bathing? • Did the bird dip or dive into water? How long did it stay under water? • Did the bird appear restless or nervous? Was it calling loudly? Why do you think this was happening? • Did you notice any territorial behaviour, such as fighting? If yes, whom did it fight with and how? • Did you see the bird collecting material for a nest? What kind of material was it collecting (twigs, cloth, plastic, wires, grains, worms, stones)? • Did you see the birds mating? • How did the bird behave near the nest? Which birds were present (male, female, or both)?
4.	Who was the bird with?	• Was the bird alone or in a group? How many birds were there? • Did you usually see the bird in pairs? If yes, what kind of pairs (male-female, male-male, female-female, or with a different species)? • Do you think the bird usually moves in groups (flocking)? Were the birds in the group of the same species or different species? How did the birds in the group interact with each other? • Did you see the bird interact with or get chased by another animal (such as an insect, dog, or reptile)? • Did you notice any other animals or birds near the nest? Were there chicks present? Did you hear them?

S. No.	Aspects to observe	Examples
5.	When do you see the bird?	• Note the day, date, time, place, and how long you observed the bird. Describe the weather when you spotted the bird. • Did you see the bird more often during the day, night, or throughout the day?
6.	Where did you see the bird?	• Describe or draw the bird's surroundings. • What type of place was the bird in (grass, shrub, small tree, big tree, water body, building, open ground)? Was it in a natural area or a human-made space? • How high or low was the bird located: was it on the ground, mid-level branches, treetop, top canopy, rooftop? Did it move between habitats (such as tree to ground, water to bank, building to tree)? • Were there any food or water sources near where you spotted the bird? • Was the bird easy to spot, or did it stay hidden? How long did it take you to find the bird?

Table I. Bird observation checklist.

C) How to describe?

There are two common ways birdwatchers describe birds:

- How the bird looked: Birdwatchers use special words for different parts of a bird's body (see **Fig. 1**). Use these words when describing the bird. For example: "*The bird had a black throat, a white belly, and a red vent.*"
- How the bird behaved: Birdwatchers also use specific words to describe behaviour (see **Table II**). For example: "*One bird was preening the other.*"

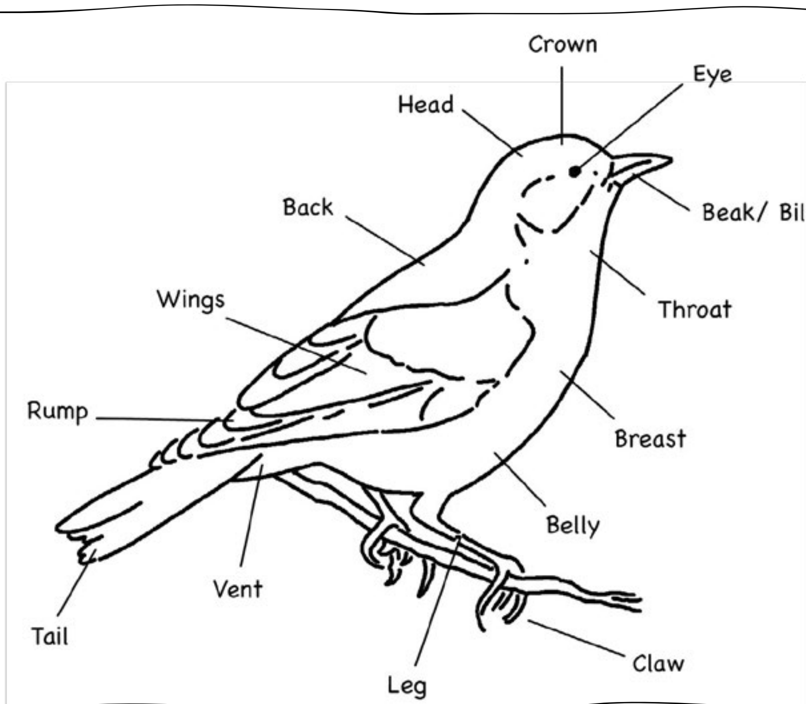


Fig. 1. Terms used to describe parts of a bird.
Credits: Image taken from Pixabay and adapted by Adithi Muralidhar. License: CC0.

S. No.	Behaviours	Term
1.	Eating food or drinking water.	Feeding
2.	Grouping together while in flight or while perching, moving, or looking for food.	Flocking
3.	Staying in air while flapping wings or soaring.	Flying
4.	Searching or looking around for food.	Foraging
5.	Coming together to breed.	Mating
6.	Building a structure to hold eggs and chicks.	Nesting
7.	Cleaning its own or another bird's feathers.	Preening
8.	Immersing its body in water to clean or cool itself.	Bathing
9.	Settling at a particular spot, in groups or alone, to rest or sleep.	Roosting
10.	Communicating with other birds.	Singing/calling
11.	Protecting a tree branch, nesting site, or area on the ground. This could involve attacking/fighting another birds or animal.	Territorial display
12.	Moving on ground/in water.	Walking/hopping/wading/ swimming
13.	Various forms of communication (like songs, dances, plumage, etc.) to attract a mate.	Courtship

Table II. Terms used to describe common bird behaviours.

i wonder...
Rediscovering school science

Contributed by:

Adithi Muralidhar, who is a Scientific Officer at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. She runs a nature blog called 'Earthly Notes' (www.earthlynotes.com). She can be reached at: adithi@hbcse.tifr.res.in.

Life in Our Backyard

TEACHER'S GUIDE:OBSERVE A BIRD IN YOUR NEIGHBOURHOOD

Azim Premji University

TEACHER'S GUIDE

About the activity

This activity helps students carefully observe birds in their neighbourhood and write down what they notice. Students will collect information about one bird and later use these observations to create different resources.

- The activity needs at least three indoor class sessions (each lasting 80–120 minutes) spread over one month.
- In addition, students will engage in short outdoor observations every day during the month.
- The activity can also be continued for several weeks, months, or even a full year. This helps students observe seasonal changes in bird presence and behaviour.

Starting the activity: Connecting to students' ideas

Teachers can begin by asking questions that help students share what they already know about birds. For example:

- Which birds do you often see near your home or school?
- Which bird do you like the most? Why?
- Have you heard any stories or songs about birds?
- What is the funniest thing you have seen a bird do?
- Which is the most colourful bird you have seen?

Students can write their answers on paper. Some students may share their responses aloud in class, and the teacher can read the remaining responses later.

Preparing students for the activity

A key goal of this activity is to help students learn how to observe birds carefully and describe what they see. Teachers can use the following fun games to build these skills:

- Poster Game: Display a picture of a commonly seen bird in the classroom (for example, a Red-whiskered Bulbul). Ask students to use the **'How to describe?'** section in the **Student Handout** to name the bird's body parts and describe how each part looks.
- Silhouette Game: Show students pictures of bird silhouettes. Examples include: Kingfisher, Gull (sea bird), Sparrow, Crow, Robin, Owl, Dove/Pigeon, Parakeet/Parrot, Swift/Swallow, Rooster/Cock, Kite/Raptor, and Heron/Egret. Ask students to guess which bird each silhouette shows and explain how they guessed.
- Picture Card Game: Make picture cards of four commonly seen birds, such as: House Crow, Indian Robin (male), Asian Koel (male), and Black Drongo. Divide the class into groups and give one picture card to each group. Ask each group to describe at least five physical features that help identify their bird. Paste all four pictures on a large chart and display it in class. The teacher can read out descriptions from each group while the rest of the class guesses the bird. More birds can be added, such as: Large-billed Crow, Indian Cormorant, Ashy Drongo, and Indian Blackbird.

Observing Bird Behaviour

Another important aim is to help students observe how birds behave and describe these behaviours using the correct terms. Teachers can show short video clips of birds doing different activities. Ask students to use the **'How to describe?'** section in the **Student Handout** to identify the behaviour and name it using the correct scientific term. Here are some examples of clips showing different bird behaviours:

- Feeding: https://www.youtube.com/watch?v=Yh8FyJEo0KE
- Making a nest: https://www.youtube.com/watch?v=7eXEH-r4amE
- Foraging: https://www.youtube.com/watch?v=Ccy4-JY98Mk
- Bathing: https://www.youtube.com/watch?v=akoAJPiEE3I
- Preening: https://www.youtube.com/watch?v=zeGE_dZyd4E
- Calling: https://www.youtube.com/watch?v=-hO_uGIxBLg
- Fighting: https://www.youtube.com/watch?v=p65q5wUpKZg

Supporting students during the activity

a) **Before starting:** Go through the **Student Handout** together in class. Spend extra time discussing the section **'Ethics to keep in mind'**. Ask students if they can think of any more precautions to avoid disturbing or harming birds and their surroundings.

b) **During outdoor observations:** Read and explain the instructions for **'Step I'** of the **Activity Sheet**. Accompany students outdoors, especially at the beginning. Ensure that each student chooses one kind of bird to observe over several weeks. Encourage them to select birds that are commonly seen nearby, such as: House Crow, Common Myna, House Sparrow, Blue Rock Pigeon, or Black Kite. Students may choose a bird themselves, or the teacher may assign one. Encourage students to write detailed notes and make careful drawings. If students find it hard to know what to observe even after a week of this activity, the teacher can sit with them and go through the questions in **'Table I'** of the **Student Handout**. These questions can guide students on what details to notice and record.

c) Read out and discuss the instructions for **'Step II'** of the **Activity Sheet** in class. Divide the

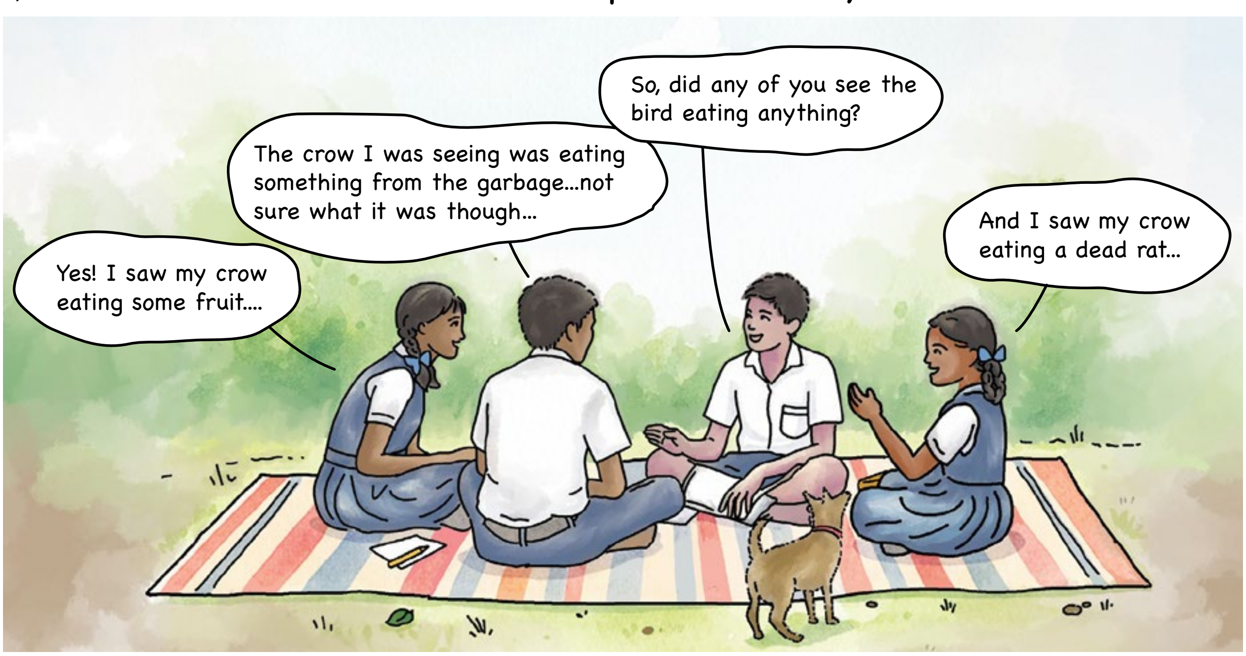


Fig. 1. An example of group work during Step II.

Credits: Image created for i wonder... by Vidya Kamalesh based on a template shared by Adithi Muralidhar.

students into groups so that each group includes students who observed the same kind of bird. For example, all students who observed the House Crow can sit together to talk about what they noticed. Ask students to compare their observations and identify similarities and differences. Encourage them to look for patterns, such as behaviours or features that appear again and again, and to think about whether they can make any general statements about the bird (see **Fig. 1**). Also ask students to note down any new questions that come up during the discussion. Students can then take another week to observe the same bird again and try to find answers to these questions.

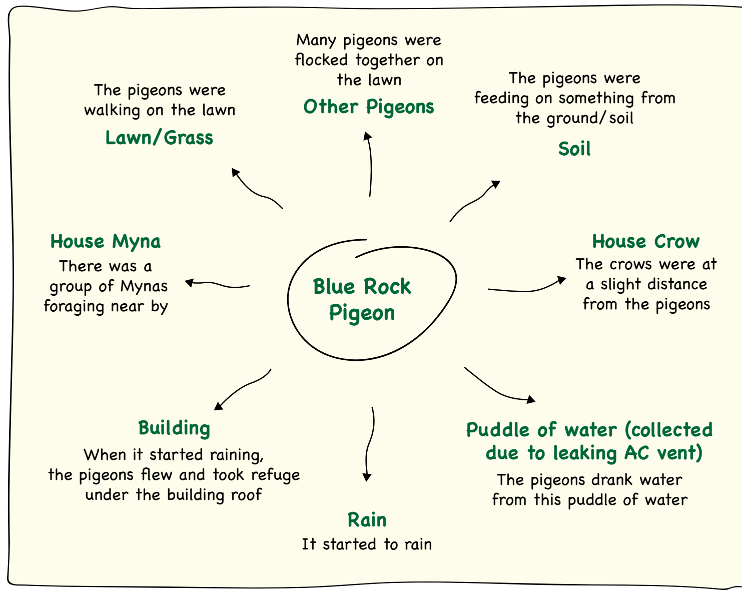


Fig. 2. An example of an interaction map for the Blue Rock Pigeon.

Credits: Adithi Muralidhar and Anand Krishnan. License: CC BY-NC-ND.

d) Read out and discuss the instructions for **'Step III'** of the **Activity Sheet** in class. After this, students can continue working individually or in groups to improve and organise their data. Along with written descriptions, students can present their observations in any visual format. For example, they may create interaction maps, flowcharts, or flash cards (see **Fig. 2**). Inform students that they are expected to submit their observation notes at the end of this session (see **Fig. 3**).

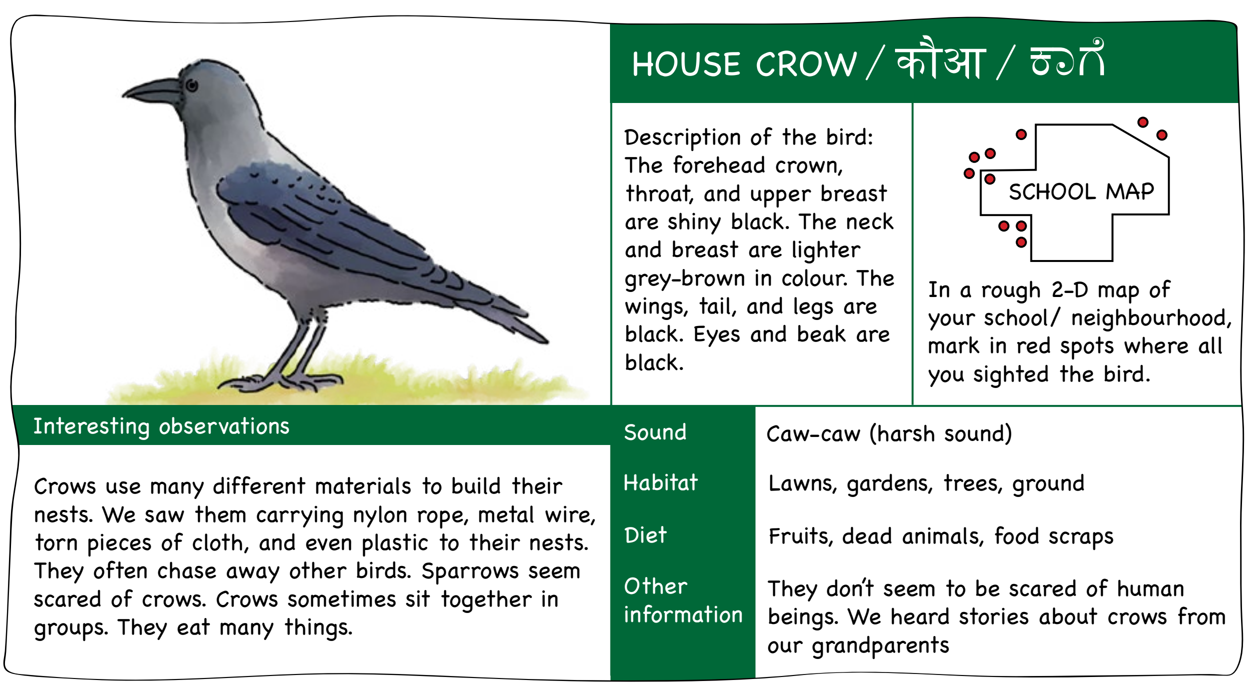


Fig. 3. An example of a possible flash card on the House Crow.

Credits: Adithi Muralidhar and Anand Krishnan. License: CC BY-NC-ND.

e) Target learning trajectory: For the bird observed by the students, help them move gradually from **'Point 1'**, the simplest level of description, to **'Point 5'**, the most detailed and thoughtful level of description (see **Fig. 4**).

1. I saw a small black bird today.

↓

2. I saw a small black bird today. It was as small as the palm of my hand.

↓

3. I saw a black bird today. It was as small as the palm of my hand. Its eye was black. It had a long tail.

↓

4. I saw a black bird, which had a brown vent. It was as small as the palm of my hand. Its eye was black. It had a long tail, white legs, and grey beak.

↓

5. I saw a black bird with a brown vent. Its height was as much as the palm of my hand, so that's around 10 cm. Its eye was black. It had a long tail, which it keeps up, white legs, and greyish beak. Its call was high-pitched.

Fig. 4. An example of a target learning trajectory in describing an Indian Robin (Male).

Source details: (a) Credits for the image: SajeevBhaskaran, Pixabay. URL: https://pixabay.com/photos/indian-robin-bird-ground-animal-5921607/. License: CC0. (b) Credits for the flowchart: Adithi Muralidhar and Anand Krishnan. License: CC BY-NC-ND.

Limitations of this activity

- Since equipment (like binoculars) is not used, some observations may be limited. Schools may consider providing such equipment if possible.
- Identifying and classifying birds is not included in this activity, as it may make the task too complex.

Advantages of this activity

- Students and teachers do not need special background knowledge (like bird taxonomy) about birds.
- The activity builds on students' everyday experiences with birds.
- It does not require expensive materials—only eyes, ears, pen, and paper.
- Students get to learn outdoors and explore their surroundings.
- Students can express their learning in many ways: writing, drawing, and talking with others.
- This activity can lead to many follow-up activities.

Extension activities

For students who want to explore further, teachers can suggest:

- Observe the bird for a year: Study the same bird for a whole year and note seasonal changes (for example, some migratory waders may look more colourful in summer and greyer in winter).
- Identify more neighbourhood birds: Learn how to use field guides to identify more birds.
- Put together a checklist of neighbourhood birds: Create posters or flash cards of local birds.
- Document stories and the cultural history of birds: Talk to elders in the community to collect stories, beliefs, and cultural knowledge about birds. This can introduce students to the study of relationships between people and birds (ethno-ornithology).
- Engage in citizen science projects related to birds.

i wonder...
Rediscovering school science

Contributed by:
Adithi Muralidhar, who is a Scientific Officer at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. She runs a nature blog called 'Earthly Notes' (www.earthlynotes.com). She can be reached at: adithi@hbcse.tifr.res.in.

METALS AND NONMETALS: A TEACHING PLAN

SHIFA KHAN

Students often struggle to apply textbook definitions of metals and nonmetals. How can teachers help them develop the conceptual understanding to sort everyday materials into these categories?

One of the competencies that students are expected to develop from the middle-stage science curriculum is the ability to use observable properties of everyday materials to classify them as metals or nonmetals (see **Box 1**).[1, 2] The concepts that support this competency are introduced gradually across different grade-level textbooks for preparatory-stage environmental studies (EVS) and middle-stage science.[3-7] I had the opportunity to explore this theme with 56 Grade IX students from three government senior secondary schools. When asked what they knew about metals, most students could list commonly taught properties—hardness, shine, malleability, ductility, and conductivity of heat and electricity—or provide examples such as gold and silver. To probe their understanding more deeply, I created a classroom display of 15 everyday objects and asked students to classify them into three categories—metals, nonmetals, or neither—based on observable properties (see the **Activity Sheet**). After completing the task, students were invited to justify their classifications. These discussions revealed significant gaps in their understanding of metals and nonmetals.[8] In this

Box 1. Curricular connections:

Discussions and activities around the classification of materials into metals and nonmetals can help teachers meet the following:

A) Curricular goals for middle-stage science:

- CG-1: Explore the world of matter and its constituents, properties, and behaviour. Specifically, it can help students develop the competency (C-1.1) to: *"Classify matter based on observable physical (solid, liquid, gas... translucent... conducting, non-conducting) and chemical (pure, impure; acid, base;* ***metal, non-metal****; element, compound) characteristics."*
- CG-6: Explore the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, it can help students develop the competency (C-6.2) to: *"Formulate questions using scientific terminology... and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments)."*[1]

B) Learning objectives for middle-stage students:

- Differentiate between commonly known materials based on their ability to be bent and formed into sheets, be drawn into wires, their ability to produce a ringing sound, their ability to conduct electricity, and their ability to conduct heat in order to define various properties of metals.
- Categorise commonly known materials as metals and nonmetals in order to explain their physical properties.[2]

article, I describe the key features of a teaching plan developed to address these gaps.

What are the properties of metals and nonmetals?

Middle-stage science textbooks introduce students to nine properties of metals (see **Table I**).[4, 6, 7] Most students were familiar with six. None mentioned sonority, corrosion on exposure to air and water, or the formation of alkaline oxides. Although students could recite textbook definitions of the six properties they were familiar with, they struggled to apply them accurately. For example, many students classified marble as a metal because it appeared shiny and malleable—they had seen polished, sheet-like marble floor tiles.[8] This misunderstanding persisted despite explicit discussion in textbooks:

- Chapter 6 ('Materials Around Us') of the Grade VI science textbook (NCERT, Reprint 2025-2026) shares the following: *"Are all lustrous materials metals? 'All that glitters is not gold' goes an old saying! Not all the materials that shine are metals. Surfaces of some materials are made shiny by polishing or coating them with thin layers of plastic, wax or any other material which makes them look shiny. These materials may not be them."*[4] I explained that marble is not naturally lustrous like metals, but can be made shiny through polishing.
- Chapter 4 of the Grade VII science textbook (NCERT, 2025) shares the following: "*Can you give some examples of metal sheets? You might have seen thin silver foil on some sweets and aluminium foil used for wrapping food items. These are formed due to their malleability. Gold and silver are the most malleable metals. A piece of coal or a lump of sulfur does not show this behaviour. They break into pieces and are said to be brittle. On the other hand, wood neither gets flattened into a sheet nor breaks into pieces. Therefore, wood is neither malleable nor brittle."*[6] This chapter suggests that teachers allow students to try hammering a collection of metals and nonmetals to observe these differences for themselves. On asking, I found that none of the students had seen marble being hammered.

Discussion revealed that students had been introduced to the properties of metals and nonmetals as definitions to memorise, rather than as ideas to be explored through observation and activity. This was surprising, given that the textbook chapters on this theme include examples and

S. No.	Metal property	Textbook definition	Textbook chapter
1	Lustrous	*"Materials that typically have shiny surfaces are said to have a lustrous appearance. Such materials with lustre are usually metals."*	Chapter 6 ('Materials Around Us') of the Grade VI science textbook (NCERT, Reprint 2025-2026).
2	Hard	*"Materials which can be compressed or scratched easily are soft, while other materials which are difficult to compress or scratch are hard."*	Chapter 6 ('Materials Around Us') of the Grade VI science textbook (NCERT, Reprint 2025-2026).
3	Sonorous	*"This property of metals that enables them to produce a ringing sound is called sonority, and metals are said to be sonorous in nature."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
4	Malleable	*"This property by which materials can be beaten into thin sheets is called malleability. Most metals possess this property."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
5	Ductile	*"This property of materials by which they can be drawn into wires is called ductility. This property of ductility is mainly possessed by metals."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
6	Good conductor of heat	*"Materials like metals that allow heat to pass through them easily are called good conductors of heat."*	Chapter 7 ('Heat Transfer in Nature) of the Grade VII science textbook (NCERT, 2025).
7	Good conductor of electricity	*"Materials that allow electricity to flow through them easily are called good conductors of electricity."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
8	Corrodes on exposure to air and water	*"Gradual deterioration of metal surfaces caused by air, water, or other substances is known as corrosion."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
9	Forms basic oxides	*"Generally, oxides of metals are basic in nature."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).

Table I. Textbook definitions of the properties of metals.[4, 6, 7] The students were able to recite accurate definitions of six of these properties.

activity ideas to help students develop a clearer understanding of these properties (see **Table II**).[3-7] Although some students recalled these activities being read aloud in class, none had actually performed them. To address this, we tried each of the activity ideas from Chapter 6 of the Grade VI textbook (NCERT, Reprint 2025-2026) and Chapter 4 of the Grade VII textbook (NCERT, 2025).[4, 6] For example, I brought the following samples to class: iron nails, pieces of coal, bricks, pieces of marble, pieces of hard plastic, thick copper wires, artificial gemstones, graphite rods, thick aluminium wires, coins, etc. Students observed and recorded what happened when each sample was struck with a hammer—did it flatten into a sheet or break into pieces? At the end of this exercise, I compiled their observations on the board and used them to discuss malleability. When asked which materials were malleable, none of the students mentioned marble. When asked why, they explained that it had broken into pieces when hammered. I confirmed that marble is not malleable and clarified that the sheet-like tiles they had seen were produced by cutting and polishing, not by hammering.

Property	Activity idea	Textbook chapter
Hardness	*"When you press different objects or materials with your hands, some of them, like stones, may be hard to compress, while others, like an eraser, can be easily compressed. Take a metal key and use it to scratch the surface of a piece of wood, aluminium, stone, iron, candle, chalk, and any other material or object. Can some materials be scratched more easily than others?"*	Chapter 6 ('Materials Around Us') of the Grade VI science textbook (NCERT, Reprint 2025-2026).
Sonority	*"Take a metal spoon and at least five objects made up of different materials—wood, metal, plastic, cloth, and glass. Gently tap the spoon on each of them. Listen to the sound that each of them makes. Make your own words to describe all these different sounds. Try to capture those sounds in words, like ting-ting, dhum-dhum, dub-dub..."*	Chapter 10 ('This World of Things') of the Grade III EVS textbook (NCERT, 2025).
	"Take a few objects, such as a metal spoon, a coin, a piece of coal, and a block of wood. (a) Drop them one by one from a certain height. (b) Do you notice any difference in the sound produced by these objects..."	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
Malleability	*"Collect some waste pieces of copper and aluminium, an iron nail, a piece of coal, a pea-sized lump of sulfur (gandhak), and a block of wood. Now, place each of these items one by one on any hard surface and beat them with a hammer. What do you think will happen? Do the objects become slightly flattened or do they break into pieces?"*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
Conduction of heat	*"Place a glass tumbler on a table. Fill it with hot water. Take a metal spoon and a wooden spoon of almost the same size and thickness. Immerse both the spoons simultaneously into the hot water... and leave them undisturbed for a few minutes. Now, carefully touch the upper end of each spoon... Which of the spoons gets hotter? What does this experiment tell us about heat transfer along the two spoons?"*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
	"Take a strip of metal, such as aluminium or iron, about 15 cm long. Attach four pins to the strip with the help of wax such that they are arranged at nearly equal distances (about 2 cm apart) ... Secure the strip to a stand and label the pins as I, II, III, and IV... (If a stand is not available, place the strip between two bricks for support.) Heat the end of the strip that is away from the stand with a candle or a spirit lamp. What will happen to the pins? Will they remain attached to the strip or will they fall? Predict the order in which the pins will fall from the strip... Do you think that heat is being transferred along the metal strip from the end that is being heated?"	Chapter 7 ('Heat Transfer in Nature) of the Grade VII science textbook (NCERT, 2025).
Conduction of electricity	*"Connect an electric cell and a lamp while leaving the two ends of the wires free... Touch the two free ends of the wires momentarily. Does the lamp glow? If yes, our tester is ready. We can use this tester to identify the materials through which electric current passes. Collect objects of different materials, such as metal spoons, coins, cork, rubber, glass, keys, pins, plastic scale, wooden block, aluminium foil, candle, sewing needle, cardboard, paper, and pencil lead. One by one, touch the free ends of the tester's wires to both ends of each object you have collected... Make sure the wires do not touch each other. Does the lamp glow every time?"*	Chapter 3 (Electricity: Circuits and their Components) in the Grade VII science textbook (NCERT, 2025).

Property	Activity idea	Textbook chapter
Corrosion on exposure to air and water	*"Take a few shining iron nails. If you are using old iron nails, make sure to remove brown deposits from their surface by scrubbing them with the help of a small piece of sandpaper. (a) Take three clean, dry glass bottles or test tubes with tight-fitting caps or stoppers. Label them A, B, and C. (b) Take three iron nails and tie each iron nail with a thread. (c) Place one iron nail and some silica gel in the glass bottle 'A', and tighten the cap or stopper... (d) Place one iron nail in the glass bottle 'B'. Pour freshly boiled and cooled water (to remove dissolved gases) into it until the iron nail is completely dipped in it. Now, pour some oil to form a layer over the surface of the water... Cap the glass bottle tightly. (e) Place one iron nail in the glass bottle 'C', and pour some water so that the iron nail is partially dipped. Keep this glass bottle unstoppered. This allows the iron nail to come into contact with both water and air... (f) Place all the glass bottles undisturbed at room temperature and observe the changes for 8-10 days."*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).
pH of oxides	*"Take a magnesium ribbon about 3-4 centimetres long. Clean it by rubbing with a piece of sandpaper. Hold it with a pair of tongs. Ignite the other end using a spirit lamp or a candle... Let the magnesium ribbon burn. What do you observe? Add a few drops of warm water to this white powder, stir it well... Find out whether the solution of magnesium oxide is acidic or basic or neutral in nature. You can use any acid-base indicator. What effect does this solution have on blue and red litmus papers?"*	Chapter 4 ('The World of Metals and Non-metals') of the Grade VII science textbook (NCERT, 2025).

Table II. A sample of textbook ideas for classroom activities.[3-7] Each of these activities are designed to help students develop a clearer understanding of the properties of metals.

Are all materials either metals or nonmetals?

Six of the 15 objects used in the initial classification activity—wood, plastic, chalk, marble, brick, and the green board—were neither metals nor nonmetals. Although students had the option to use this category, very few did so (see **Table III**).[8] Discussion revealed that many students believed that all materials must be either metals or nonmetals. As a result, they relied on the metal properties they were familiar with to classify objects into these categories:

- Objects that showed one or more of these properties were often classified as metals. For example, over half the students classified wood and plastic as metals because they were hard. Some noted that plastic could appear shiny, while others referred to plastic sheets and insulated wires to argue that plastic was malleable and ductile.
- Objects that did not show these properties were typically classified as nonmetals. Chalk, for example, was widely classified as a nonmetal because it was neither hard nor shiny—two properties many students believed all metals must possess.

Objects	Number of student responses (total = 56)			
	Metals	Nonmetals	Neither	Blank
Wooden chair and table	33	23	0	0
Piece of hard plastic	34	22	0	0
Chalk	0	35	11	10
Piece of marble	41	0	0	15
Brick	4	22	10	20
Green board	2	21	10	23

Table III. This is how students had classified six everyday objects.[8] Although none of these objects were made of metals or nonmetals, many students assumed that they must have one of these two categories of materials.

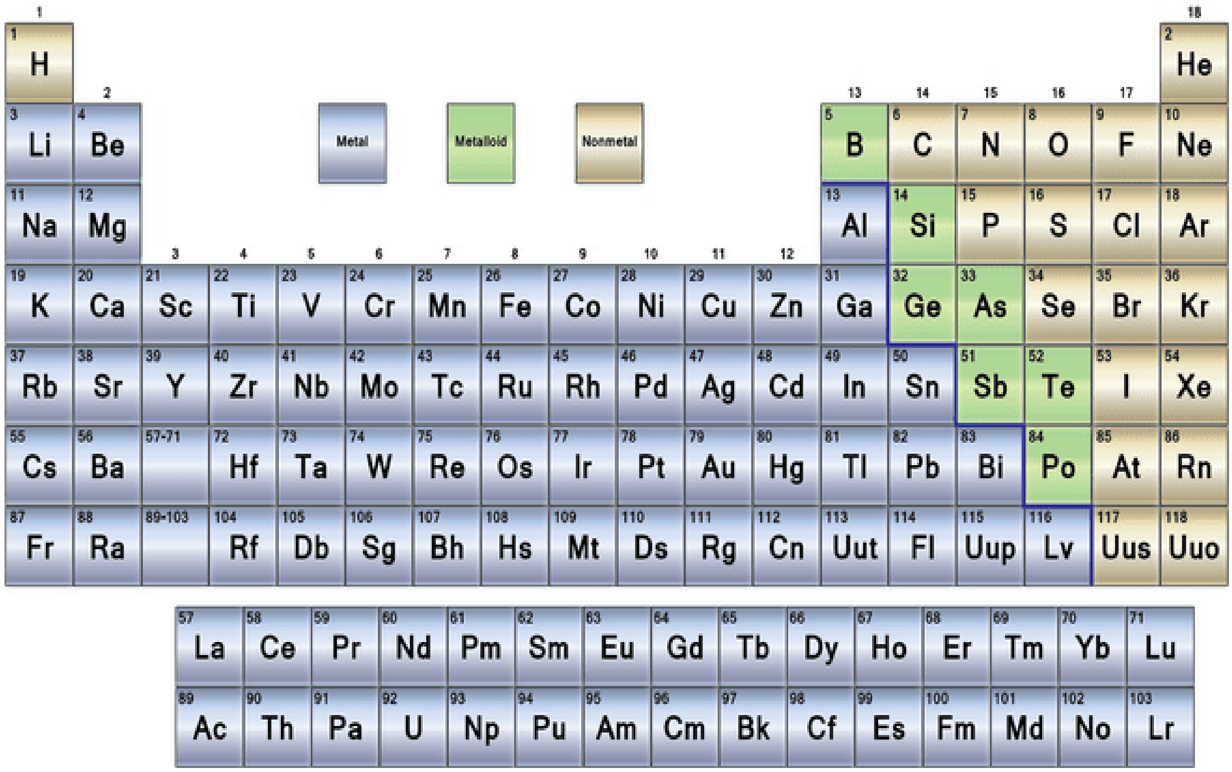


Fig. 1. The periodic table, colour-coded to highlight metals, nonmetals, and metalloids.

Credits: Julen Aduriz EHU, Wikimedia Commons. License: CC BY-SA 4.0 International Deed. URL: https://commons.wikimedia.org/wiki/File:Metalak_taula_periodikoan..png.

Chapter 4 of the Grade VII science textbook (NCERT, 2025) defines nonmetals in the following way: *"Substances like sulfur and phosphorus... are usually soft and dull in appearance. They are neither malleable nor ductile, and they are not sonorous. They are also poor conductors of heat and electricity. These are called nonmetals. Their oxides are acidic in nature. Some other nonmetals are oxygen, hydrogen, nitrogen, carbon, etc."*[6] But this chapter also points out that nonmetals *"...must not be confused with materials such as plastic, glass, wood, rubber, and paper. These materials are not classified as metals or nonmetals because they are not elements."*[6] It then introduces students to the term 'elements': *"Metals and nonmetals are sub-categories of substances called elements. An element is a substance that cannot be broken down into simpler substances. in nature. Presently, 118 elements are known. These elements are the basic building blocks of all matter."*[6] I discussed these ideas in more detail with the students. I then displayed a periodic table, highlighting only those elements that are mentioned in the preparatory-stage EVS and middle-stage science curricula (see **Fig. 1**). Among metals, I highlighted sodium, potassium, magnesium, calcium, iron, cobalt, nickel, copper, zinc, gold, silver, mercury, and aluminium. Among nonmetals, I highlighted carbon (including coal, graphite, and diamond), hydrogen, nitrogen, oxygen, sulphur, and iodine. This provided an opportunity to explain that while most metals and nonmetals showed the properties listed in their textbooks, there are some exceptions. I reminded the students that:

- Most of them (43 of 56 students) had classified mercury as a nonmetal because it is a liquid at room temperature and lacks hardness, lustre, malleability, and ductility.
- Most of them (45 of 56 students) had classified diamond as a metal because of its hardness and shine.
- Most of them (43 of 56 students) had classified graphite as a metal because it is shiny and

conducts electricity—something the students had tested using a simple circuit provided in class.[8]

I also pointed out that:

(a) Not all elements are metals or nonmetals; some are metalloids. Metalloids show properties of both (for example, they are hard and solid, but brittle and non-sonorous).[9]

(b) Not all materials are elements. Some are compounds, and others are mixtures. Both these materials can contain metals and/or nonmetals. But compounds *"...are formed when different elements combine in fixed ratios to form something entirely new."*[9] So the properties of compounds are different from their constituent elements. In contrast, mixtures are formed when *"...two or more substances are mixed, where each substance retains its properties."*[9] Here, I drew the students' attention to the coins and the steel spoon. Fifty-five of 56 students had classified both as metals because of properties such as shine, hardness, malleability, and electrical conductivity (which they had tested using the circuit). I confirmed that both objects do show metal-like properties, but explained that they are alloys. This concept of alloys as *"mixtures of metals"* is first introduced to students in Chapter 10 ('This World of Things') of the Grade IV EVS textbook (NCERT, 2024).[3] This chapter includes the following note to the teacher: *"Show the children some common metals around you, such as iron, copper, aluminium, gold, silver, mercury in a thermometer or alloys such as steel, brass, and bronze."*[3] It also suggests some activity ideas for the classroom (see **Table IV**).[3] I supplemented this discussion by showing the students a collection of everyday objects made of different alloys, including cutlery, tools, doorknobs, medals, cans, pipes, and simple jewellery.

S. No.	Activity ideas
1	*"**Understand your classroom**: Draw a picture of your classroom in your notebook. Label the things that you have drawn. The hinges, nails, and latches of the door are made of some metals."*
2	*"**Spot the metals:** Find as many things or parts of things that are made of metals. Which metals do you recognise around you? If you do not know the name of the metal, ask your friends or an elder. Make a list of these metals in your notebook."*
3	*"**What material is your spoon made of?** Is it made of metal, wood, or some other material? Can you guess?"*

Table IV. A sample of activity ideas around metals and alloys from the preparatory-stage EVS curriculum.[3] Each of these activities is designed to encourage students to observe and become more familiar with metals and alloys in their immediate world.

Parting thoughts

A month after the initial exercise, I invited students to repeat the classification activity. During their first attempt, the students had based their classification mainly on: (a) Their ability to identify materials mentioned as examples of metals or nonmetals in the middle-stage science textbooks, and (b) The presence or absence of 1-2 properties, typically hardness and shine. This time, the students analysed the objects for the presence or absence of each of the seven physical properties they had learned to associate with metals. After the students had finished the exercise, I asked if they could identify one property in the list that all metals show and no nonmetals show. The answer was, *"No."* When asked about hardness and shine, most students agreed that neither property was, alone, sufficient to classify a material as a metal. When asked why, they explained that mercury is a metal, but not hard; while diamond and steel are hard and shiny, but not metals. I then drew attention to the wording used in Chapter 4 of the Grade VII science textbook (NCERT, 2025): *"We learnt that metals are **generally** hard, lustrous, malleable, ductile, and good conductors of heat and electricity."*[6] Emphasising the word 'generally'. I suggested that analysing a material's composition and observing as many of its properties as possible can make our classification of it more accurate. We ended the class on this note.

Key takeaways

- Multiple chapters of the preparatory-stage EVS and middle-stage science textbooks describe the properties of metals and nonmetals, and share examples of these materials from our everyday world.
- Students may accurately memorise these definitions and examples, but asking them to apply the ideas to unfamiliar materials or to exceptions often reveals gaps in understanding.
- One such gap lies in students' understanding of the properties of metals and nonmetals. The textbooks suggest several hands-on activities to help students explore these properties and identify exceptions through direct handling of materials. It is important that teachers give students the opportunity to do these activities in class.
- Another gap concerns the idea that metals and nonmetals are categories of elements. Not all elements belong to these categories, and not all materials are elements. This can be addressed through a basic introduction to elements, compounds, and mixtures that focuses only on the metals and nonmetals that middle-stage students are familiar with.

Notes:

(a) Credits for the image (Listening to the sound of tapping a steel *thali* with a steel spoon in schoolyard) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Nov 2025). License: CC BY-NC-ND.

(b) This article includes one detachable classroom resource: **Activity Sheet: Are these Everyday Objects Made of Metals or Nonmetals?**

References:

1. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
2. Central Board of Secondary Education (2020). 'Teachers' Resource for Achieving Learning Outcomes, Classes 1 to 10'. URL: https://cbseacademic.nic.in/web_material/Manuals/TeachersResource_LODoc.pdf.
3. National Council of Educational Research and Training (2025). 'Chapter 10: This World of Things'. Our Wondrous World, Textbook of EVS (The World Around Us) for Grade III: 123-134. URL: https://ncert.nic.in/textbook.php?ceev1=10-12.
4. National Council of Educational Research and Training (Reprint 2025-2026). 'Chapter 6: Materials Around Us'. Curiosity, Textbook of Science for Grade VI: 101-122. URL: https://ncert.nic.in/textbook.php?fecu1=6-12.
5. National Council of Educational Research and Training (2025). 'Chapter 3: Electricity: Circuits and their Components'. Curiosity, Textbook of Science for Grade VII: 23-40. URL: https://ncert.nic.in/textbook.php?gecu1=3-12.
6. National Council of Educational Research and Training (2025). 'Chapter 4: The World of Metals and Nonmetals'. Curiosity, Textbook of Science for Grade VII: 41-56. URL: https://ncert.nic.in/textbook.php?gecu1=4-12.
7. National Council of Educational Research and Training (2025). 'Chapter 7: Heat Transfer in Nature'. Curiosity, Textbook of Science for Grade VII: 89-104. URL: https://ncert.nic.in/textbook/pdf/gecu107.pdf.
8. Khan, Shifa (2025). 'Classifying everyday materials as metals and nonmetals'. i wonder..., 13: 32-38. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6318/.
9. National Council of Educational Research and Training (2025-2026). 'Chapter 8: Nature of Matter: Elements, Compounds, and Mixtures'. Curiosity, Textbook of Science for Grade VIII: 116-133. URL: https://ncert.nic.in/textbook.php?hecu1=8-13.

Shifa Khan has been working with Azim Premji Foundation since 2014. She has a postgraduate degree in Chemistry from Dr Harisingh Gour University, Sagar, Madhya Pradesh. Her main interests lie in travelling, listening to Sufi music, teaching children, and learning material related to the history of science. She can be contacted at: shifa.khan@azimpremjifoundation.org.

DID YOU KNOW?

WHY DO WE USE DIFFERENT METALS FOR COOKING POTS?

Look at the pots and pans in your kitchen. You may find aluminium, steel, iron, or copper. How many different metals and alloys can you identify? Have you wondered why we do not use a single material for all cooking? Different metals have different physical and chemical properties, which make them more suitable for specific kinds of cooking. Here are some examples:

- **Aluminium (lightweight and fast-heating):** Aluminium conducts heat efficiently, so it heats up quickly and distributes heat relatively evenly. This property makes it suitable for cooking foods like milk or rice, which require moderate heating without long cooking times. Aluminium is lightweight and easy to handle. However, it is soft and can bend or scratch easily. It can also react with acidic foods if uncoated. Many aluminium utensils are now coated, anodised, or combined with other metals to increase durability and reduce chemical reactions. Aluminium melts at about 660 °C, so it is not suitable for extremely high temperatures.
- **Iron and cast iron (heat-retaining and strong):** Iron and cast-iron utensils are heavy and dense. They heat up more slowly than aluminium, but retain heat for longer periods, which is useful for slow cooking, such as making *rotis* on a *tawa*. Cast iron is hard and long-lasting, though it is brittle and can crack if dropped. Iron can rust if left wet, so these utensils should be dried carefully after washing.
- **Stainless steel (durable and corrosion-resistant):** Stainless steel is an alloy of iron containing chromium ($\geq$10.5%) and sometimes nickel. The chromium forms a protective oxide layer that prevents rusting. Stainless steel is strong, hard, and resistant to corrosion, denting, or scratching. It does not react significantly with most foods. However, stainless steel does not conduct heat as efficiently as aluminium or copper, so many stainless-steel utensils include a base layer of copper or aluminium to improve heat distribution.
- **Copper (high heat conductivity):** Copper conducts heat very efficiently, which allows rapid and uniform temperature changes. This property is useful for tasks that require precise temperature control. Copper can react with acidic foods, so it is usually lined with another metal such as tin or stainless steel. Copper is often used for the base of utensils or fully lined to prevent direct contact with food.

What does this tell us? There is no single 'best' metal for cooking. Metals are chosen based on their properties—how they conduct heat, how strong they are, whether they rust, and how they react with food.

Question for students: Look around your kitchen, home, school or neighbourhood and list three cooking or household objects made of a metal. For each object, ask:

- Why might this metal have been chosen for this job?
- What property of the metal makes it suitable—or unsuitable—for this use?
- Would a different metal work better? Why or why not?

Remember, people did not learn about metals from textbooks. They learned by watching, touching, breaking, bending, and trying again—just like scientists do. Science is not done only in laboratories—it is also practised in everyday places like our kitchens.

ACTIVITY SHEET: ARE THESE EVERYDAY OBJECTS MADE OF METALS OR NONMETALS?

What to do:

The table below lists 15 everyday objects. You may have seen many of these at home or in school. Your teacher may also have displayed some of these objects or the materials they are made up of in the classroom.

Look closely at each object and think about the material it is made of. You can observe the objects in the classroom display to notice their properties (such as hardness, shine, or malleability).

The table has three categories: Metals, Nonmetals, and Neither. Using what you observe and what you already know, tick all the categories that you think apply to each object. Use the last column of the table to share reasons for your classification.

	Objects	Metals	Nonmetals	Neither	Reasons for your classification
1	Piece of hard plastic				
2	Sulphur crystals				
3	Graphite rod from a pencil				
4	Some coins				
5	Piece of marble				
6	Gold ring or earring				

	Objects	Metals	Nonmetals	Neither	Reasons for your classification
7	Steel spoon				
8	Piece of brick				
9	Mercury thermometer				
10	Aluminium foil				
11	Wooden chair or table				
12	Iron rod				
13	Diamond				
14	Chalk				
15	Green board				

Think about and discuss:

- Did you notice any properties that many metals share? Are there any that all metals have in common?
- Did you notice any properties that many nonmetals share? Are there any that all nonmetals have in common?
- Did any material surprise you by behaving like both a metal and a nonmetal? Explain what you observed. How did you classify these materials?
- Did you find any materials that did not behave like metals or nonmetals? What did you notice about them? How did you classify them?
- Can you think of some ways of testing and verifying your classification?

i wonder... Rediscovering school science

Contributed by:
Shifa Khan, who has been working with Azim Premji Foundation since 2014. She can be contacted at: shifa.khan@azimpremjifoundation.org.

THE SCIENCE EDUCATOR AT WORK

EXPLORING SOIL:
THE FOUNDATION OF LIFE

MAADOO TEAM

Soil forms the foundation of agricultural ecosystems. Can school science and social science curricula be linked with traditional practices to help students from farming families understand their role in preventing soil erosion?

Chapter 12 ('How Nature Works in Harmony') of the Grade VIII science textbook (NCERT, 2025) shares how ecosystems are formed through *"...interactions between the biotic components (plants, animals, and microorganisms) and the abiotic components (air, water,* ***soil****, sunlight, and temperature) in a habitat."*[1] Drawing attention to how crucial ecosystems are for human survival and well-being, it shares how: *"Human activities like pollution, deforestation, habitat loss, climate change, invasive species, and overexploitation of natural resources threaten ecosystems. Protecting them... is vital."*[1]

Many students in the government schools we work with in Kanakapura taluk, Ramanagara district, Karnataka, are from farming families. Farms are the immediate ecosystems they are part of and recognise as being important for their well-being. Fertile soil is the foundation of these ecosystems. What role can students play in protecting soil? We explored this question through hands-on activities supported by inquiry-based discussions.

What is soil?

Chapter 1 ('Natural Resources and their Use') of the Grade VIII social science textbook (NCERT, 2025) poses the following question to students: *"In many indigenous traditions of the world, Nature is considered sacred... In such traditions, Nature is a nurturer and nourisher. Do you know of practices that reflect this?"*[2] Our experience suggests that beginning a lesson with an engaging puzzle, poem, short story, or an incident drawn from students' immediate surroundings can be an effective way to capture their attention. So we began a discussion with our 24 Grade VIII students with a familiar Kannada verse:

ಬೆಳಗಾಗಿ ನಾನೆದ್ದು ಯಾರ್ಯಾರ ನೆನೆಯಾಲಿ
ಎಳ್ಳು ಜೀರಿಗೆ ಬೆಳೆಯೋಳ | ಭೂಮ್ತಾಯ
ಎದ್ದೊಂದು ಗಳಿಗೆ ನೆನೆದೇನ ||[3]
(At dawn, whom shall I remember? The one who nurtures sesame and cumin—Mother Earth herself; I remember her with each waking moment.)

Some students were surprised to encounter a verse in a science class. One remarked, "ಈ ತರ ಬೇರೆ ಎಲ್ಲೋ ಕಲಿತ ವಿಷಯಗಳನ್ನ ಇನ್ನೊಂದು ವಿಷಯದಲ್ಲಿ ಲಿಂಕ್ ಮಾಡಬಹುದು ಅಂತ ಅಂದುಕೊಂಡಿರ್ಲಿಲ್ಲ | *(I never thought that things learned in one subject could be linked to another subject like this).*" We asked our students: *What is the meaning of this verse? What is its main point?* Through discussion, students were able to appreciate how this simple verse reflects the deep bond between people and soil. They were also able to relate to how farmers see Mother Earth not only as the source of food, but also as the giver of life, and begin their day by remembering her with gratitude. In Chapter 1 ('Crop Production and Management') of the Grade VIII science textbook (NCERT, 2024-2025), students read that: *"...soil contains minerals, water, air, and some living organisms."*[4] To make this idea more concrete, we invited students to collect soil samples—no more than a handful

Fig. 1. Examining soil samples. Students **(a)** collected soil samples from the vicinity; **(b)** observed differences in their appearance and texture; and **(c)** documented their observations. Note: The facial features of the child in (b) have been blurred to protect their privacy.

from each location—from their immediate surroundings (see **Fig. 1**). Back in the classroom, students began by reporting what they could directly observe. They described the colour of the soil and identified the materials present in it, such as sand, stones, insects, paper, plastic, sticks, and leaves.

To encourage deeper exploration, students can be reminded that Chapter 13 ('Our Home: Earth, a Unique Life-Sustaining Planet') of the Grade VIII science textbook (NCERT, 2025) states: *"Soil may look like simple dirt, but it is rich in nutrients like nitrogen and potassium that plants need to grow."*[5] Gradually, students' observations extended to soil characteristics that could be sensed through touch, including texture and water content. These were features students had seen their parents or elders traditionally use in the fields to decide which crops could be grown. If students are keen, they can be encouraged to compare soil samples for their ability to support plant growth (see **Activity Sheet I**).

We concluded the class by drawing students' attention to Chapter 2 ('Land, Soil, Water, Natural Vegetation, and Wildlife Resources') of the Grade VIII social science textbook (NCERT, 2024–2025), where they read: *"Soil is made up of organic matter, minerals and weathered rocks found on the earth."*[6]

Natural curiosity led some students to ask: *How is soil formed?* Others offered ideas—some suggested that running water brings soil, while others thought volcanic eruptions create it. Surprisingly, one student believed humans created soil and asked, *"How could soil have formed before humans existed?"* Most students recognised that soil formation is a slow, natural process.

Instead of reiterating textbook explanations, we played a short animated video titled 'How Was Soil Formed from Rocks' and explained the visuals in Kannada to support understanding.[7] To stimulate deeper thinking, we posed questions grounded in their own farming experiences: *How deep is soil? Does it remain the same as we dig deeper? Have you noticed distinct layers while digging a pit or trench?* Drawing on these experiences, students recognised that soil consists of multiple layers.

To make this concept more tangible, we divided the class into groups of five to seven. Each group received cardboard cut-outs representing different soil layers and was asked to arrange them based on their observations and prior knowledge (see **Fig. 2a**).[8, 9] After completing the task, groups presented their arrangements to the class and explained their reasoning. We then played a second video, 'Soil Profile of Earth – Soil Layers and Horizons', allowing students to compare their models with the video and identify which parts were accurate and which needed revision.[10]

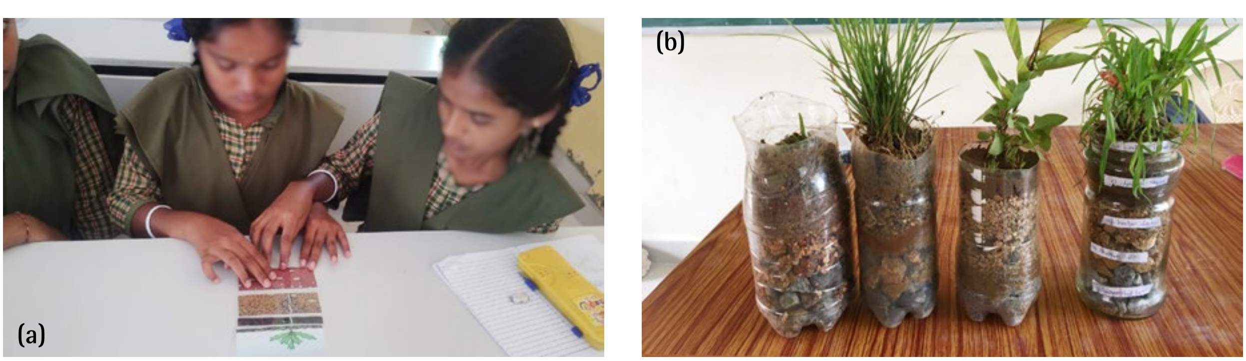


Fig. 2. Probing soil layers. Students **(a)** used prior knowledge to arrange cut-outs of soil layers; and **(b)** put together creative representations of soil profiles after they had watched a video showing the correct arrangement of soil layers. Note: The facial features of the children in (a) have been blurred to protect their privacy.

Finally, students were pointed to Chapter 2 of the Grade VIII social science textbook (NCERT, 2024–2025), which describes soil's four layers: (a) topsoil, rich in humus and vegetation; (b) subsoil, containing sand, silt, and clay; (c) weathered rock material; and (d) parent rock.[6] Students were encouraged to use materials from their surroundings to create visual displays of these layers (see **Fig. 2b**).

Why does soil matter?

In Chapter 13 of the Grade VIII science textbook (NCERT, 2025), students read: *"Beneath our feet lies something remarkable—the Earth's crust, made of rocks, soil, and minerals. It may seem hard and lifeless, but it provides almost everything life needs to grow and survive."*[5] They also read: *"There are various types of landforms, rocks, soils, etc., on Earth. This variety, along with the processes that shape and alter them, is called geodiversity... It helps create unique habitats where different types of life can thrive."*[5] To help students grasp the scarcity of arable land, we used an onion to represent the Earth, removing portions corresponding to oceans, deserts, mountains, and settlements form it. Students could see that only a small fraction of land remained available for farming.[11] This connects to Chapter 1 of the Grade VIII science textbook (NCERT, 2024–2025), where students learn that topsoil is the only layer that supports plant growth.[4] We pointed out that the thin outer layer of the small fraction of arable land on the planet is all that humanity has to grow food. This visualisation helped students develop a more concrete appreciation for how limited and precious this thin layer of soil is.

This naturally led to the question: *What holds topsoil in place?* In Chapter 12 of the Grade VIII science textbook (NCERT, 2025), students read that *"...soil provides medium and essential nutrients for plant growth"* and plant *"...roots hold soil in place and prevent erosion."*[1] Rather than telling students this, we adapted a hands-on activity suggested in Chapter 2 of the Grade VIII social science textbook (NCERT, 2024–2025): "*Take two trays, A and B, of the same size. Make six holes at one end of these trays and then fill them with the same amount of soil. Leave the soil in tray A bare while sow wheat or rice grains in tray B. When the grain in tray B has grown a few centimetres high, place both the trays in such a way that they are on a slope. Pour one mug of water from the same height into each tray. Collect the muddy water that trickles down the holes of both trays in two separate containers and compare how much soil is washed out of each tray."*[6] Students were invited to work in groups to grow crops in shallow trays (see **Activity Sheet II**). Each tray was prepared with a mixture of soil and manure. We chose seeds such as finger millet, green gram, and *jowar* for the activity because they are commonly available in students' homes and germinate quickly. Students were instructed to soak the seeds overnight before planting. Each group then sowed its assigned seeds and cared for the plants, ensuring adequate sunlight and regular watering.

A week later, students brought their trays to class and shared their observations. Many had monitored their plants closely, noting when seeds germinated, how sprouts emerged through the soil, the shapes of the leaves, and changes in leaf number over time. Some trays showed healthy, lush growth, while others displayed sparse or uneven growth. This variation likely resulted from differences in seed type or the level of care the plants received. Rather than treating this as a failure, trays with limited growth became an important comparison for the next stage of the activity.

In the next step, a small hole was made at the bottom of each tray, and a plastic pipe approximately six inches long was attached to simulate drainage. Water was then poured into the trays to mimic rainfall (see **Fig. 3**). Transparent cups were placed beneath the pipes to collect the water that flowed out of the soil. The cups were labelled and arranged side by side, and students recorded differences in the appearance of the collected water and discussed possible reasons for these variations (see **Fig. 4**). Through this activity, students were able to identify some factors that contribute to soil erosion and appreciate the role of vegetation in preventing it (see **Table I**).

Fig. 3. Simulating rain. Students used a watering can with a shower head to simulate rain. Note: The facial features of the children have been blurred to protect their privacy.

Appearance of water in cup	Plant growth in tray	Inference
Clear, very little soil	Dense growth of the same kind of seedlings.	Very little soil loss
Clear, almost no soil	Dense and mixed growth of seedlings.	Almost no soil loss
Dark and muddy	Sparse or patchy growth	Significant soil loss

Table I. A record of the students' results.

Parting thoughts

Referring to the trays that had shown significant soil loss in the previous activity, we introduced the term 'soil erosion', defining it as the washing away of topsoil by rain or wind. We connected this to Chapter 2 of the Grade VIII social science textbook (NCERT, 2024–2025), where students read: *"Soil erosion and depletion are the major threats to soil as a resource. Both human and natural factors can lead to degradation of soils."*[6] In Karnataka alone, 7,522 hectares of cultivated land have been affected by soil erosion.[12]

We asked students: *How can soil erosion be prevented?* Drawing on their observations, many students suggested growing more plants. To inspire

Fig. 4. Comparing soil loss. After the simulated rains, students could see for themselves that trays with more, and more diverse, plants lost less soil, while trays with fewer plants lost more soil.

Box 1. Curricular connections:

These activities and discussions can help meet the following:

A) Curricular goals for middle-stage science:

- CG-3: [The student] explores the living world in scientific terms. Specifically, it can help students develop the competency (C-3.3) to: *"Analyse patterns of relationships between living organisms and their environments in terms of dependence on and response to each other."*
- CG-6: [The student] explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, it can help students develop the competency (C-6.2) to: "*Formulate questions using scientific terminology (to identify possible causes for an event, patterns, or behaviour of objects) and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments).*"[15]

B) Learning outcomes (LO) for:

- **Middle-stage science**: [The student] conducts simple investigations to seek answers to queries, relates processes and phenomena with causes, and applies learning of scientific concepts in day-to-day life.
- **Grade VII science**: [The student] makes efforts to protect the environment. For example, ... by planting trees to avoid soil erosion; sensitising others with the consequences of excessive consumption of natural resources, etc.
- **Grade VIII social science**: [The student] justifies judicious use of natural resources such as water, soil, forest, etc. to maintain development in all areas.[16]

them, we shared the story of Jadav Payeng, who transformed degraded land on the Majuli islands in Assam by planting and nurturing saplings that eventually grew into a forest.[13, 14] This forest has helped reduce soil erosion and restore ecological balance. Students listened with great interest, and some even planted a few saplings in their backyards.

Returning to the earlier discussion, we asked students to think of practices that could reduce soil erosion on their farms. Observing that trays with mixed seeds showed very little soil loss, some students suggested growing different kinds of plants together. We explained that this practice is called 'multi-cropping' and is common on many small, traditional farms. This prompted students to share practices from their own communities. For example, some described how their parents and elders build *bunds* on sloped farmland to prevent rainwater runoff and loss of topsoil, and how these *bunds* are regularly checked and reinforced, especially after heavy rains.

We also discussed how soil erosion not only reduces soil fertility, but can contribute to floods, landslides, and other natural disasters. We then explained the preventive measures listed in Chapter 2 of the Grade VIII social science textbook (NCERT, 2024–2025): Mulching, building rock dams, contour ploughing, terrace farming, crop rotation, intercropping, and planting shelter belts.[6] Some students spoke about the trees they had seen on their farms. Before this exploration, they had assumed that the trees were mainly used to provide fodder to sheep and goats. They now recognised that the trees also help bind farm soil and maintain its health.

While most of our students come from farming communities, this exploration helped them appreciate the importance of conserving the thin, fertile layer of topsoil on their field and beyond. It also enabled them to connect observations from their everyday lives with concepts in their science and social science textbooks (see **Box 1**).[15, 16] We concluded the discussion here, but plan to organise a class visit to nearby fields so students can observe and document soil conservation practices used by farmers in their own community.

Key takeaways

- The Grade VIII curriculum introduces students to the role of ecosystems and the importance of protecting them.
- Farms are the most immediate ecosystems that students from agricultural families can relate to, and healthy soil is the foundation of these ecosystems.
- By collecting and observing properties of soil samples from the vicinity, students can link scientific analysis with the ways their elders decide which crops to grow in different soils.
- Asking students to draw on their experience of digging soil to create displays of its layers enables them to identify and understand soil profiles through their own observations.
- A hands-on activity that lets students test how vegetation affects soil erosion helps them understand why protecting topsoil is important and recognise traditional farming practices that reduce soil loss.

Notes:

(a) Credits for the image (Reinforcing bunds after the rains) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

(b) This article includes two detachable classroom resources: **Activity Sheet I: What properties of soil help plants grow well?** and **Activity Sheet II: Do Plants Help Stop Soil from Washing Away?**

References:

1. National Council of Educational Research and Training (2025). 'Chapter 12: How Nature Works in Harmony'. Curiosity, Textbook of Science for Grade VIII: 190–209. URL: https://ncert.nic.in/textbook.php?hecu1=12-13.
2. National Council of Educational Research and Training (2025). 'Chapter 1: Natural Resources and their Use'. Social Science Textbook (Exploring Society: India and Beyond) for Grade VIII: 1–20. URL: https://ncert.nic.in/textbook.php?hees1=1-7.
3. ಕನ್ನಡ ನುಡಿ (n.d.). ಗೀತವಿಹಾರ: ಜಾನಪದ ಗೀತೆಗಳು. 'ಬೆಳಗಾಗಿ ನಾನೆದ್ದು ಯಾರ್ಯಾರ ನೆನೆಯಾಲಿ'. URL: https://kannadanudi.com/geethavihaara/jaanapada/Belagagii%20Naneddu%20Yaryara%20Neneyali#google_vignette.
4. National Council of Educational Research and Training (2024–2025). 'Chapter 1: Crop Production and Management'. Curiosity, Textbook of Science for Grade VIII: 1–16. URL: https://ncert.nic.in/textbook/pdf/hesc101.pdf.
5. National Council of Educational Research and Training (2025). 'Chapter 13: Our Home: Earth, A Unique Life Sustaining Planet'. Curiosity, Textbook of Science for Grade VIII: 210–228. URL: https://ncert.nic.in/textbook.php?hecu1=13-13.
6. National Council of Educational Research and Training (2024–2025). 'Chapter 2: Land, Soil, Water, Natural Vegetation and Wildlife Resources'. Social Science Textbook (Exploring Society: India and Beyond) for Grade VIII: 7–21. URL: https://ncert.nic.in/textbook/pdf/hess402.pdf.
7. Bodhaguru (2014). 'Science – How Was Soil Formed from Rocks (3D Animation)—English'. YouTube video. URL: https://www.youtube.com/watch?v=Fx8r3o2gsLk.
8. Worksheets Library. 'Layers of Soil: Worksheet 362005'. URL: https://worksheets.clipart-library.com/worksheet/soil-layer-worksheet-4.html.
9. Worksheets Library. 'Layers of Soil: Worksheet 362058'. URL: https://worksheets.clipart-library.com/worksheet/soil-layer-worksheet-19.html.
10. MocomiKids (2022). 'Soil Profile of Earth – Soil Layers and Horizons'. YouTube video. URL: https://www.youtube.com/watch?v=vqtdFaclWf0.
11. Farm to Home Lesson Series (2018). 'Earth: The Apple of Our Eye'. YouTube video. URL: https://www.youtube.com/watch?v=-vquGl0d3LQ.
12. Ministry of Agriculture & Farmers Welfare (2022). 'Survey on Soil Erosion'. Press Information Bureau, Government of India. URL: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1810912.
13. Sony BBC Earth (2023). 'Meet Jadav Payeng: The Forest Man of India'. Earth Champion Series, YouTube video. URL: https://www.youtube.com/watch?v=w8OtZUcjKFU.

14. McMaster, William D (2014). 'Forest Man'. YouTube video. URL: https://www.youtube.com/watch?v=HkZDSqyE1do.
15. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
16. National Council of Educational Research and Training (2017). 'Learning Outcomes at the Elementary Stage'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/publication/otherpublications/tilops101.pdf.

MaaDoo Team is a hub for experiential learning based out of Ramakrishna Mission, Shivanahalli with support from Texas Instruments and Youth for Seva. It is led by Project Director, Murali S, along with four project coordinators: Jaikumar R, Nagesh OS, Nenike Hussain Basha, and Mamatha R. The team aims to sustain and inculcate curiosity in an integrated approach connecting to life skills and ensure that students learn collaboratively through activities, games, model building, nature walks, talking to village elders, skits, and music, among other things. The team can be contacted at: maadoo.in@gmail.com.

DID YOU KNOW?

EARTH IS THE ONLY PLANET WE KNOW THAT HAS TRUE SOIL

When we dig our hands into soil on Earth, it may feel ordinary. However, from a planetary perspective, soil as it exists on Earth is rare. Based on current evidence, Earth is the only known planet with soil that contains a combination of organic matter, living organisms, and long-term water-driven processes.

Why do scientists consider other planets unlikely to have soil? Space missions to the Moon, Mars, and asteroids have allowed detailed study of their surfaces. Samples returned from the Moon, along with images and chemical data from Mars rovers, show that these bodies are covered with regolith—a layer of loose rock fragments and dust formed by meteor impacts, temperature changes, and wind. Scientists do not classify regolith as soil because it generally lacks organic matter, active organisms that mix materials and recycle nutrients, and sustained evidence of liquid water modifying the material over long periods. These conclusions come from analysing samples, rover measurements, and comparisons with Earth's soils. Interestingly, Earth itself did not always have soil. For the first several hundred million years, its surface was largely bare rock. Weathering and erosion created early loose materials, but soil as we define it—including organic contributions from life—developed later. Scientists infer that soil formation became more extensive as liquid water stabilized on the surface, the atmosphere became suitable for sustaining life, and microorganisms and plants colonized the land. Evidence includes chemical patterns in ancient rocks, fossilized roots, and ancient river deposits. Over hundreds of millions of years, soils have become deeper and more complex through ongoing interactions between rock, water, air, and life. Other planets lack some of these conditions. For example, Mars is cold, dry, and exposed to strong radiation at the surface. Rover and orbital data indicate no evidence of active life and only limited periods when liquid water may have existed.

Do we need soil to grow plants on another planet? Experiments on the International Space Station show that plants can grow without soil using hydroponic or nutrient-rich artificial systems. This demonstrates that short-term plant cultivation is possible without natural soil. However, soil naturally performs multiple functions—retaining water, supplying nutrients, supporting roots, and hosting microorganisms—that otherwise require energy-intensive technology. Transporting soil from Earth is impractical because its microbial community would not survive space conditions. Scientists are therefore exploring whether soil-like systems could be created elsewhere. Based on Earth's history, developing such systems would require liquid water, a stable surface, microorganisms, and long periods of time. Experiments with Martian soil simulants show that plant growth is poor unless organic matter and microbial communities are added, highlighting that soil is not just crushed rock but a product of long-term interactions among rock, water, air, and life.

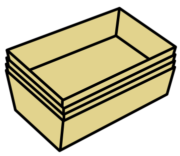
What does this tell us about Earth? Soil results from the planet's unique combination of surface water, atmosphere, and biological activity over geological time. These same conditions also support life itself. This is why scientists searching for life elsewhere focus on water, stable surfaces, and signs of biological processes.

Question for students: Look around your home or school. Where do you see soil being formed, protected, or damaged? If scientists discovered a planet with water and rocks but no life, what would you predict about its soil? What evidence would you look for to support your prediction?

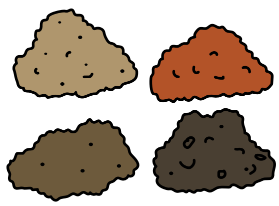
ACTIVITY SHEET I: WHAT PROPERTIES OF SOIL HELP PLANTS GROW WELL?

Aim: To observe how different kinds of soil affect seed germination and plant growth.

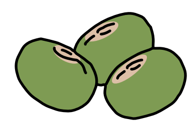
What you will need:



Four shallow trays or plastic containers

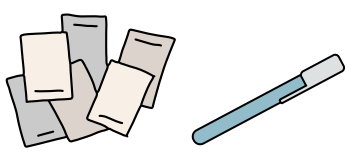


Different soil samples (like sandy soil, soil from a field, clayey soil, and soil mixed with manure)



One kind of seed (green gram grows within 24–48 h) for all trays

Water



Labels and marker

Notebook for observations

What to do:

1) Soak the seeds in water overnight.
2) Make small holes at the bottom of the trays for drainage. You may ask your teacher for help.
3) Label the trays as:
    - Tray A: Sandy soil
    - Tray B: Soil from a field or garden
    - Tray C: Clayey soil
    - Tray D: Soil used in Tray B but mixed with manure
4) Place the trays on a flat surface and ensure the drainage holes are not blocked.
5) Fill about 3–4 cm of each tray with the soil on the label.
6) Sprinkle the same number of seeds in each tray. Make sure the seeds are evenly spaced out.
7) Cover the seeds lightly with a thin layer of the soil used in the tray. Try to make sure that the seeds in all 4 trays are at the same depth.
8) Gently sprinkle water on the soil in each tray until the soil is moist, not soggy.
9) Place all the trays in the same area. Choose an area that is well-lit with indirect sunlight.
10) Water the trays lightly every day. Use the same amount of water for each tray.

11) Observe the trays for one week.

Observe and record:

- Seed type:
- How long did you soak the seeds in water?
- How do the soaked seeds look?

S. No.	What to observe?	Tray A	Tray B	Tray C	Tray D
1.	How does the soil feel (loose, sticky, sandy, crumbly, etc.)?				
2.	How does the soil look (dark, light, etc.)?				
3.	How does the soil smell (dusty, earthy, slightly sweet, etc.)?				
4.	Does the soil look the same when dry and when wet? After you water the soil, does it become compact or stay loose? Does water soak into the soil quickly or does it stay on the surface?				
5.	Do you notice small insects, ants, or earthworms in the soil?				
6.	How many days does it take for the first seedling to appear?				
7.	How many seeds germinate in a week?				
8.	Gently remove one seedling from the tray. How do the roots look? Are they long and spread out, or short and weak?				
9.	Feel the soil near the roots of a few seedlings. Does it feel firm or loose?				
10.	How quickly do the seedlings change in height?				
11.	How many of the seedlings in the tray look green and healthy? How does this change?				
12.	How do the leaves look? How do they change in size and colour?				

Think about and discuss:

Q1. All four trays have the same number of green gram seeds. They receive the same amount of light and water. In which tray:

a) Do the seeds sprout first?

b) Do you see the most seedlings at the end of a week?

c) Do the seedlings show the fastest growth? What evidence supports this?

Q2. What do your observations of plant growth on the four trays tell you about the kind of soil that green gram:

a) Seeds prefer for germination?

b) Seedlings prefer for growth?

Q3. If you used a different kind of seed, do you think there would be any difference in your observations? Why? When you test this, does it show what you guessed?

Q4. What role does water play in plant growth? Think about what happens (share observations) to seedlings (their roots, leaves, stems) that grow in soil that:

a) Is too dry or cannot hold water?

b) Stays too wet?

Q5. What role does air play in plant growth? Think about what happens (share observations) to seedlings (their roots, leaves, stems) that grow in soil that is:

a) Too loose?

b) Too compacted?

Q5. What role do the following play in plant growth and what evidence supports this:

a) Dry leaves and manure

b) Living organisms

Q6. Could soil be providing seeds and seedlings with things besides water? What might these be? What evidence supports this?

Q7. Say you were offered 8 samples of soil and asked to choose one sample that would be best for plant growth. What properties of soil would you look for and why?

Q8. Why is it important for farmers and gardeners to improve the quality of soil?

i wonder... Rediscovering school science

Contributed by:

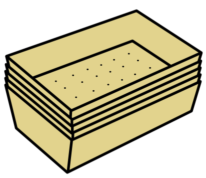
Chitra Ravi, who works at Azim Premji University, Bengaluru. She can be contacted at: chitra.ravi@apu.edu.in.

MaaDoo Team, a hub for experiential learning in Anekal taluk, Bengaluru. It includes four project coordinators: Jaikumar R, Nagesh OS, Nenike Hussain Basha, and Mamatha R. The team can be contacted at: maadoo.in@gmail.com.

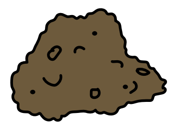
ACTIVITY SHEET II: DO PLANTS HELP STOP SOIL FROM WASHING AWAY?

Aim: To compare how rain affects soil in areas with different kinds of plant cover.

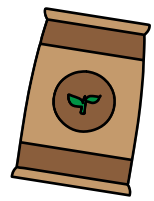
What you will need:



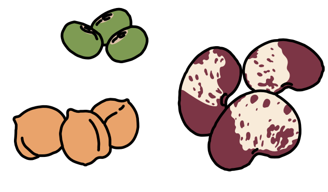
Five shallow trays or plastic containers with small holes at the bottom



Soil (dark and crumbly with an earthy and sweet smell)

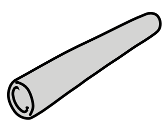


Manure

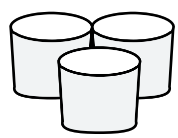


Three different kinds of seeds

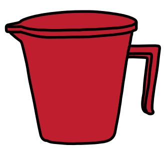
Water



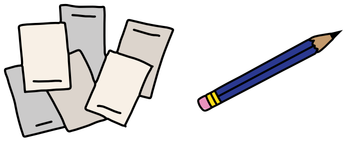
Plastic pipe (six inches long)



Five clear plastic cups



A mug



Labels and pencil

Notebook for observations

Step 1. Grow seeds on a tray (group activity):

1) Your teacher will divide your class into groups and give your group a tray and one batch of seeds.
2) Mix the manure with the soil.
3) Place the tray on a flat surface and ensure the drainage holes are not blocked.
4) Fill about 3–4 cm of the tray with soil.
5) Sprinkle the seeds on the soil in the tray. Make sure the seeds are evenly spaced out.
6) Cover the seeds lightly with a thin layer of soil.
7) Label your tray with the names of your group members, the name of the seed assigned to you, and the date on which you plant the seeds.

8) Gently sprinkle water until the soil is moist, not soggy.

9) Place the tray in an area that is well-lit with indirect sunlight. If this is in school, you will see the trays assigned to the other groups in your class.

10) Water the tray lightly every day till the seedlings grow a few centimetres tall. This can take a week or a couple of weeks.

Step 2. Seeing the effect of rain (class activity):

1) Bring your tray to class. The other groups in class will also bring their trays. These trays will have:
    - Tray A: Soil + manure (prepared by your teacher)
    - Tray B: Soil + manure with Seed 1
    - Tray C: Soil + manure with Seed 2
    - Tray D: Soil + manure with Seed 3
    - Tray E: Soil + manure with a mixture of Seeds 1, 2, and 3

2) Your teacher will place the five trays in such a way that they are on a slope. They will make a small hole at the bottom end (lowest part of the slope) of your tray and attach a plastic pipe to it.

3) You and your group mates can place the clear plastic cup or mug below the pipe so that it catches anything that comes out of the pipe.

4) Fill the mug with water. Pour it slowly and at a steady rate near the part of the tray that is at the highest end of the slope. Discuss with your classmates and fix the height from which you pour the water. This height should be the same for all groups.

5) One of your group members can collect the water that flows out of the pipe (run-off) in a clear plastic cup.

Observe and record:

Observe the water and soil collected in each container.

S. No.	What to observe?	Tray A	Tray B	Tray C	Tray D	Tray E
1.	Plant growth (dense, sparse)					
2.	Speed of water flow in pipe					
3.	Colour of water in cup					
4.	Amount of soil in cup					
5.	Appearance of soil surface on tray after collecting run-off					

Think about and discuss:

Q1. Which tray loses the most soil? What evidence supports your answer?

Q2. How does the denseness of plant growth affect the movement of water through the tray?

Q3. Which is better at reducing soil erosion: growing one kind of crop or growing different crops together? What evidence supports your answer?

Q4. What parts of a plant holds soil together? What evidence supports your answer?

Q5. Which of these would show less soil erosion: forests or open fields? Why?

Q6. Why do you think farmers grow crops or grasses on slopes?

Q7. What might happen to soil, in places that receive heavy rains for example, if farmers grow only one crop on their fields year after year?

Q8. Why are grasses planted along roads and riverbanks?

Q9. Can you think of some ways we (humans) can reduce soil erosion in real life?

i wonder... Rediscovering school science

Contributed by:

MaaDoo Team, a hub for experiential learning in Anekal taluk, Bengaluru. It includes four project coordinators: Jaikumar R, Nagesh OS, Nenike Hussain Basha, and Mamatha R. The team can be contacted at: maadoo.in@gmail.com.

INVESTIGATING HOW MILK TURNS TO CURD

ROHINI KARANDIKAR

The process of setting curd is a simple everyday practice in many Indian homes. Can teachers use an investigation into this process to offer a hands-on introduction to what it means to think like a scientist?

Chapter 1 ('Exploring the Investigative World of Science') of the Grade VIII science textbook (NCERT, 2025) opens with the following passage: "*We don't want you to just learn new facts; we want you to learn how to find new facts. Investigation in science means more than just looking at something and asking only simple questions. Now you can ask more focused questions, and design ways to perhaps do simple experiments to answer those questions, and then use your observations to improve your understanding. In doing so, each of you will not just be learners but also investigators, young scientists, exploring real-world puzzles. These may range from everyday life... to the bigger mysteries of Earth and beyond...*"[1] One such real-world puzzle that can be used to introduce students to scientific investigation is the conversion of milk to curd.

Students are likely to be familiar with this process, as setting curd is a routine practice in many Indian households. Investigating this familiar process in the science classroom, however, can open up rich learning opportunities for curious students who are just beginning to explore the world of science. For example, Activity 2.9 in Chapter 2 ('The Invisible Living World: Beyond Our Naked Eye') of the Grade VIII science textbook (NCERT, 2025) encourages students to compare the effect of adding a spoonful of curd to lukewarm milk versus cold milk.[2] But this is only one aspect of curd formation. There are many other questions related to this process that students can explore through simple and inexpensive activities. A small space, careful observation, and a willingness to experiment with milk and curd (and clean up afterwards) may be all that is needed for such investigations (see **Box 1**).[3, 4] I share some possibilities.

How is curd different from milk?

Students can begin by comparing small, unlabelled samples of milk and curd. They should be encouraged to use all their senses except taste, and to record observations to justify their answers. Students typically note that curd is thicker and has a sour smell. These initial observations can be expanded with questions such as:

- *Is milk always runny? Can boiling affect its thickness? How thick is curd? Can curd be thin and runny? Can its thickness be controlled?*
- *What does milk smell like? Does curd always smell sour? Is fresh curd different from older curd? Would adding a few drops of lemon juice to milk produce a curd-like smell?* (This can be tested in class.)

These observations set the stage for deeper investigation into the properties of milk and curd (see **Activity Sheet I**). Two suggested methods are:

(a) Smudge test: This method requires a flat transparent surface, like that of a glass slide. Droppers can be used to put a drop of milk on one glass slide and a drop of curd on another slide. Teachers can draw students' attention to how the two liquids move through the dropper. Does it take more or less time for the curd to move through? If students smudge each of these liquids on its slide and compare the results, can they see any clear observable differences in their consistency? Students are likely to see that a milk smudge is much smoother than that of curd (which appears clumpy), and milk tends to concentrate at the centre of the smudge (see **Fig. 1**). It may be useful to remind students to use separate droppers and fingers (for smudging)

Box 1. Curricular connections:

These activities and discussions can help meet the following:

A. Curricular goals for middle-stage science:

- CG-6: [The student] explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, it can help students develop the competency (C-6.2) to: *"Formulate questions using scientific terminology... and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments)."*
- CG-7: [The student] communicates questions, observations, and conclusions related to science. Specifically, it can help students develop the competency (C-7.1) to: *"Use scientific vocabulary to communicate science accurately in oral and written form, and through visual representation."*[3]

B) Curricular expectations for middle-stage science: Students are expected to develop process skills of science which includes observation(s), posing question(s), searching various resources of learning, planning investigations, hypothesis formulation and testing, using various tools for collecting, analysing, and interpreting data, supporting explanations with evidences, critically thinking to consider and evaluate alternative explanations, reflecting on their own thinking.[4]

C) Learning outcomes (LO) for middle-stage science:

- Conduct simple investigations to seek answers to queries.
- Relate processes and phenomena with causes.
- Apply the learning of scientific concepts in day-to-day life.[4]

to handle the two samples. This can be shared as a general lab precaution, but students can also be invited to think about and share reasons why this precaution may be necessary in this specific activity.

(b) pH test: Chapter 2 ('Exploring Substances: Acidic, Basic, and Neutral) of the Grade VII science textbook (NCERT, 2025) explains that: *"… substances that taste sour tend to contain acids and are acidic in nature."*[5] Students are then asked to find the name of the most common acid present in curd. Teachers can start this part of the activity by asking students to predict if milk and curd are acidic, basic, or neutral. Also invite them to support their answers with reasoning. Students are likely to predict that curd is acidic. They can then be asked to test their predictions using pH paper. If access to pH paper is limited, a small piece of it can be used to demonstrate the difference in pH between the two liquids. Teachers can do this themselves or invite two students to demonstrate this to the class. Students typically find curd more acidic (~4.5–5.5) than milk (~6.5–6.7). If pH paper is unavailable, students can prepare and use graded natural acid-base indicators like the extract of red cabbage or China rose, if available. These indicators can help students observe that curd is more acidic than milk. This exercise can highlight another application of the natural indicators students read about in Chapter 2 of the Grade VII science textbook (NCERT, 2025).[5]

This activity can reinforce that scientific observation can involve 'multiple' senses and be refined using 'simple tools'. It can also be used to probe students' understanding of the change involved in curd formation. Chapter 5 ('Changes Around Us: Physical and Chemical') of the Grade VII textbook (NCERT, 2025) draws students' attention to many common examples of change from everyday life (like boiling water, chopping vegetables, etc.). They are then introduced to two categories of change: *"A physical change is one in which a substance or object undergoes a change in its physical properties and no new substance is formed. A chemical change is one in which one or more new substances are formed. It involves a chemical reaction and can be represented by a chemical equation."*[6] Students can be asked questions like:

- Is the conversion of milk to curd a physical or chemical change? Or both?
- Is this change permanent or reversible? Can curd be turned back into milk?

Students can be encouraged to justify their responses with observations of the differences between milk and curd.

Fig. 1. How is a milk smudge different from a curd smudge? Ask students to describe the difference between the two.
Credits: Rohini Karandikar.

How is milk changed to curd?

This investigation can begin by asking students how curd is prepared. Many are likely to respond that a fresh batch of curd is made by adding a spoonful of old curd to milk. Popular belief and some online resources suggest that fresh curd can be made without old curd using alternatives such as lemon juice, silver coins, or green/red chillies (see **Fig. 2**). A short article or video on this theme can be shared with students.

Students can then be divided into groups of 5–6 to explore this question through a hands-on activity (see **Activity Sheet II**). This activity may take 5–6 hours, so it is best to start at the beginning of the school day, with observations continuing until the last period. Groups can assign different students to record observations at regular intervals. Once students have completed the activity, each group can be invited to share their conclusions with the class. Typical findings include: (a) Milk left alone does not form curd, (b) Fresh curd forms only when old curd is added, (c) A silver coin does not turn milk into curd, and (d) Adding lemon juice to milk produces *paneer* (cottage cheese), not curd.

Students can now be invited to consider if milk spoilage, *paneer* formation, and curd formation are physical or chemical changes. They can also be asked: *Are there differences in the changes involved in these processes*? Students can use pH paper to compare the acidity of fresh milk with spoilt milk, *paneer*, and curd. This allows them to observe, for themselves, that all three processes increase acidity. Guided discussion can help students understand that while all three processes involve irreversible chemical changes, milk spoilage and curd formation also involve biological changes. Teachers can explain that *paneer* forms when acid (like from lemon juice) coagulates milk proteins (casein), separating them from whey, whereas curd and spoilt milk become acidic due to bacterial fermentation.

Teachers can ask: *What does old curd contain that turns milk into a fresh batch? Does it change the chemistry or biology of milk?* Students may relate to this passage from Chapter 2 of the Grade VIII science textbook (NCERT, 2025): *"...curd contains several types of bacteria. One of them is Lactobacillus. This bacterium feeds on the sugar in the milk (lactose), multiplies, and ferments the milk to form curd... these bacteria produce lactic acid, which makes curd sour."*[2] Teachers can explain that these bacteria are collectively called **lactic acid bacteria** (or LAB). Here are some other questions that students can be encouraged to think about:

- When we use old curd to set new curd, we are transferring some live LAB from the old curd to fresh milk. Scientists who study microbes (microbiologists) would call the old curd a starter culture. The live LAB then grows in the milk. When we eat curd, are we eating live or dead bacteria?
- Is eating live LAB healthy or unhealthy for us? From everyday experience and what they hear at home, many students are likely to think of curd as healthy food. In Chapter 9 ('Life Processes in Animals') of the Grade VII textbook (NCERT, 2025), students read that: "*Fibre-rich food, and especially 'fermented foods' (like curd, buttermilk, shrikhand, kanji, pickles, gundruk, and poita bhat) are good for a healthy digestive system and overall well-being.*"[7] Teachers can also encourage students

Fig. 2. Is old curd needed to start a fresh batch of curd? Ask students to predict which of the three samples of milk will turn into curd.

Credits: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Nov 2025). License: CC BY-NC-ND.

to try this exercise from the 'Discover, design, and debate' section of Chapter 2 of the Grade VIII textbook (NCERT, 2025): *"With the help of your parents and teachers, list some traditional food items from your area that utilise the process of fermentation. Investigate the ingredients used in the preparation of these fermented food items; the method of preparing them; the microorganism responsible for the fermentation of the food, and the cultural and nutritional importance of the fermented food."*[2] Having students share their findings in class can help them appreciate the everyday uses of fermentation as a metabolic process where microbes like yeast and bacteria convert sugars into alcohol, gases, or acids.

Similarly, teachers can ask students what causes milk that is left to itself to spoil. Likely that some students may relate this question to this passage in Chapter 2 of the Grade VIII science textbook (NCERT, 2025): "*Have you ever seen...any other food item rot after being left outside for some time?... This happens because they have been infected by microbes."*[2] Teachers can share that this process is also caused by bacteria and can pose these follow-up questions from the same chapter of the textbook: *"But where did these microbes come from? How did they come in contact with the food?"*[2] Responses to this question can be used to draw students' attention to the fact that *"... microorganisms can be found everywhere, be it in water, soil, air, or even in some food items."*[2] Here are some questions that students can be encouraged to think about:

- Can senses other than taste be used to detect milk spoilage? Why is it important to avoid using the sense of taste in detecting spoilage of food or water? Chapter 3 ('Health: The Ultimate Treasure') of the Grade VIII science textbook (NCERT, 2025) shares how *"...contaminated drinking water or food"* can cause disease.[8] What about spoiled milk? How would drinking it affect us?
- In Chapter 2 of the Grade VIII science textbook (NCERT, 2025), students learn that pickles and *murabbas* do not spoil because they have high concentrations of salt or sugar, which prevent microbes from growing on them.[2] Chapter 3 of the Grade VIII science textbook (NCERT, 2025) suggests that infections can be prevented by taking simple precautions like *"keeping ourselves and our surroundings clean"*, *"washing hands with soap and water to remove pathogens"*, and *"boiling"* water before drinking it.[8] Would similar precautions help prevent milk spoilage?
- Milk spoils quickly, but when converted to curd, it remains edible longer. Does this have anything to do with the *Lactobacillus* in the old curd? Can fermentation be seen as a process of food preservation?

Teachers can use this discussion to point out that, unlike *paneer* formation (a chemical change), curd formation and milk spoilage involve both chemical and biological changes. They can also pose the question asked in Chapter 5 of the Grade VII science textbook (NCERT, 2025): *Are all changes desirable?* In the same chapter, students read: "*Many useful changes happen in our daily life. For example, the* ***changing of milk into curd****, ripening of fruits, cutting of fruits, and cooking of food. All these are desirable changes... On the other hand, some changes may be undesirable, such as the rusting of iron or* ***the decay of food*** *during its storage."*[6]

Parting thoughts

The National Curriculum Framework for School Education (NCF-SE) 2023 emphasises the need for school education to help students develop capacities for scientific inquiry. An investigation into the conversion of milk to curd can help teachers introduce students to the scientific process in a simple, inexpensive, and yet practically relevant way. It can also allow students to relate many middle-stage science concepts about acids and bases, physical and chemical changes, and microbes to their everyday lives. Such explorations can enable students to *"...understand the world around them with increasing depth, explore scientific questions at different levels through discussion and experimentation, and learn to communicate this understanding in different ways."*[1]

Key takeaways

- Setting curd from milk is a familiar practice in many Indian homes. Investigating this everyday process in the classroom allows teachers to introduce students to scientific inquiry in a simple, accessible, and inexpensive way.
- Encouraging students to carefully observe and record differences between milk and curd helps them recognise how scientific investigation draws on multiple senses and on simple tools such as glass slides, pH paper, or graded natural indicators.
- Hands-on explorations of whether old curd is required to set new curd enable students to connect ideas about physical and chemical changes, as well as the beneficial and harmful roles of microbes to situations from their everyday lives.

Acknowledgements:

This article and related classroom resources were first published in i wonder..., August 2019, pp. 43–46. Previous versions are available at: https://publications.azimpremjiuniversity.edu.in/2099/. The original version has been modified by Chitra Ravi to include direct connections to the classroom instruction of chapters and concepts in the middle-stage science curriculum. The resource versions have been modified similarly with questions that encourage students to think critically about textbook concepts. The i wonder... team thanks the author for permission to publish the revised versions.

Notes:

(a) Credits for the image (Preparing curd) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

(b) This article includes two detachable classroom resources: **Activity Sheet I: How is milk different from curd?** and **Activity Sheet II: What causes milk to change to curd?**

(c) Fresh milk is nearly neutral (pH ~6.5–6.7) and curd is mildly acidic (pH ~4.5–5.0). Litmus paper and some simple natural indicators (like turmeric root extract) cannot reliably show the small difference in acidity between the two liquids. Some graded natural indicators, such as extracts of red cabbage or China rose, may show that curd is more acidic than milk. But the difference can often be subtle and difficult to detect, depending on the concentration and freshness of the indicator as well as lighting conditions. pH paper, with its graded colour scale, is the most reliable classroom tool to show that curd is more acidic than milk.

References:

1. National Council of Educational Research and Training (2025). 'Chapter 1: Exploring the Investigative World of Science'. Curiosity, Textbook of Science for Grade VIII: 1-7. URL: https://ncert.nic.in/textbook.php?hecu1=1-13.
2. National Council of Educational Research and Training (2025). 'Chapter 2: The Invisible Living World: Beyond Our Naked Eye'. Curiosity, Textbook of Science for Grade VIII: 8-27. URL: https://ncert.nic.in/textbook.php?hecu1=2-13.
3. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
4. National Council of Educational Research and Training (2017). 'Learning Outcomes at the Elementary Stage'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/publication/otherpublications/tilops101.pdf.
5. National Council of Educational Research and Training (2025). 'Chapter 2: Exploring Substances: Acidic, Basic, and Neutral'. Curiosity, Textbook of Science for Grade VII: 7-22. URL: https://ncert.nic.in/textbook.php?gecu1=2-12.
6. National Council of Educational Research and Training (2025). 'Chapter 5: Changes Around Us: Physical and Chemical'. Curiosity, Textbook of Science for Grade VII: 57-72. URL: https://ncert.nic.in/textbook.php?gecu1=5-12.
7. National Council of Educational Research and Training (2025). 'Chapter 9: Life Processes in Animals'. Curiosity, Textbook of Science for Grade VII: 121-136. URL: https://ncert.nic.in/textbook.php?gecu1=9-12.
8. National Council of Educational Research and Training (2025). 'Chapter 3: Health: The Ultimate Treasure'. Curiosity, Textbook of Science for Grade VIII: 28-35. URL: https://ncert.nic.in/textbook.php?hecu1=3-13.

Rohini Karandikar works as a consultant at TNQ Foundation in Bengaluru, Karnataka. She completed a PhD from the Department of Biosciences and Bioengineering, Indian Institute of Technology (IIT) Bombay, Mumbai, and worked as a postdoctoral fellow at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai. Rohini is interested in Science Education, Science Communication, and Biology Education. She can be contacted at: rohinikarandikar84@gmail.com.

ACKNOWLEDGEMENTS

We thank **Nithish Bhardwaj, Akkammadevi Patil, and Chandrakant Reddy** for enabling us to observe their work with preparatory-stage Environmental Studies (EVS) and middle-stage science teachers in government schools in **Kalaburagi and Yadgir**. We are grateful to **Vinay Suram** for guidance in planning this visit, and to **Shilpa Todalbagi** and **Jagannath Dengi** for introducing us to teachers they work closely with.

We thank **Savita Reddy madam** (Head Teacher) and **Jyoti madam** from Government Model Primary School, Naribola; **Shivanandayyah sir** from Government Higher Primary School, Naduvinahalli; **Munir Patel sir** from Government Higher Primary School, Kotnoor; **Maruti sir** from Government Model Primary School, Korwar; **Renuka madam** from Government Higher Primary School, Azadpur; **Mrityunjay sir** from Government Higher Primary School, Venkatbennur; **Devindrappa Shabadhi sir** (Head Teacher), **Haseena madam**, **Divya Bharti madam**, and **Shilpa madam** from Government Higher Primary School, Hattikuni; and **Nagalakshmi madam** and **Jyothi madam** from Government Higher Primary School, Mundaragi, for allowing us to be part of their classrooms (see **Fig. 1**).

Fig. 1. Observations of classroom practice in government schools. **(a)** Haseena madam's EVS class at GHPS, Hattikuni, Yadgir, combined movement and play with learning. **(b)** Jyothi madam's science class at GMPS, Naribola, Kalaburagi, involved learning through dissection, observation, and discussion. Credits: Vijeta Raghuram. License: CC BY-NC-ND.

We thank **Rajashri Nayak** and **Anil Angadiki** at the Azim Premji Schools (APS) Kalaburagi and Yadgir respectively for sharing how a school culture of openness, inclusiveness, and respect shapes classroom instruction. Special thanks to **Bhagyashree, B Navaneetha, Darshan,** and **Geetha** for inviting us into their classrooms and including us in their class discussions. We also thank **Basayya**, **Preethi**, and **Suraj** for making time to discuss their experiences of teaching science with us and sharing how collaboration helps teachers refine their practice.

Our thanks to **Rakesh**, **Suresh**, **Kiran KC, Mohammed Amjadali, Geetanjali Poojari, Mohammed Arshad, Preetham M K, Sharankumar Salagare, Shivakumar K, and Suryakant Mishra** from the Kalaburagi science team for sharing their experience of reading and using 'i wonder...' in workshops and classrooms. We also thank **Jyothika M** and **Shobha K Gunde** for coordinating several school visits.

Finally, we thank the children in the schools we visited for welcoming us into their classrooms and sharing their questions, energy, and enthusiasm.

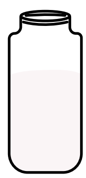
Radha Gopalan, Vijeta Raghuram, and **Chitra Ravi.**

This issue of i wonder... includes five '**Did You Know**' boxes, contributed by Chitra Ravi (chitra.ravi@apu.edu.in) from Azim Premji University, Bengaluru. If you would like to contribute content for these boxes for our next issue, please send 250-700-word pieces to: iwonder@apu.edu.in, with the subject line: 'Did you know: (title of your box)'. Each box should explore a question or theme linked to preparatory-stage EVS or middle-stage science. While written for teachers, each box should also include a question that invites students to observe, reflect, and investigate using simple everyday materials. The i wonder... team looks forward to reading your submissions.

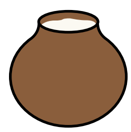
The Science Lab

ACTIVITY SHEET I: HOW IS MILK DIFFERENT FROM CURD?

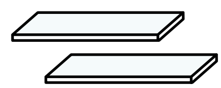
What you will need:



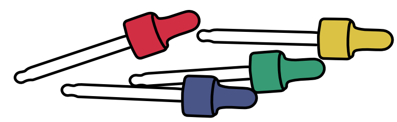
A sample of milk



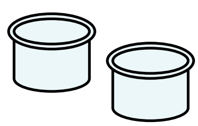
A sample of curd



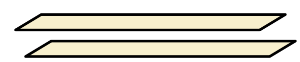
Two glass slides



Four droppers



Two transparent tubes or medicine bottle caps



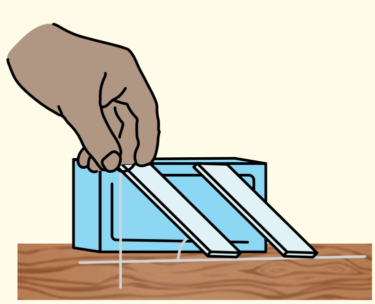
Two small strips of pH paper or a natural indicator (like that made from red cabbage)

What to do:

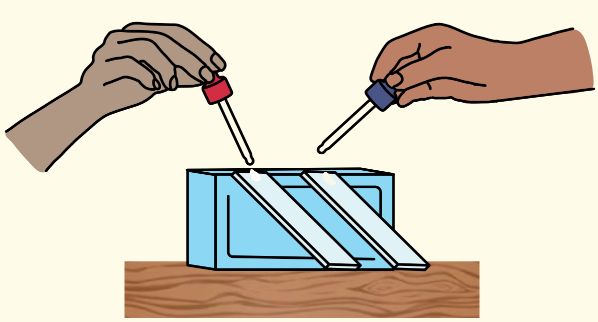
1. Smell the two liquids carefully. Do they smell the same or different? Try to describe the smell of each liquid in one word.
2. Place two glass slides against a support so that they slope at about 45°. Using a dropper, place one drop of one liquid near the top edge of the first slide. Ask a classmate to place one drop of the other liquid at the same position on the second slide. Observe carefully.

   (a) Do the drops stay in one place or move down the slide? Do they move at the same speed, or does one move faster?

   (b) Do the drops leave a mark or streak behind? Is there a difference in how these streaks look?

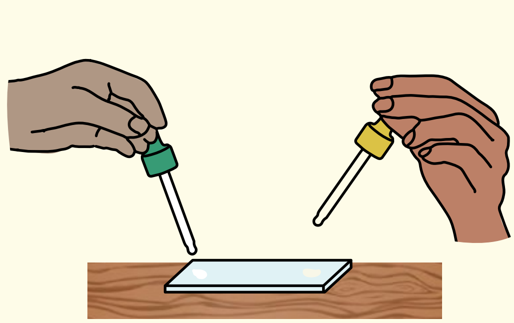


~45 degrees inclination of glass slides

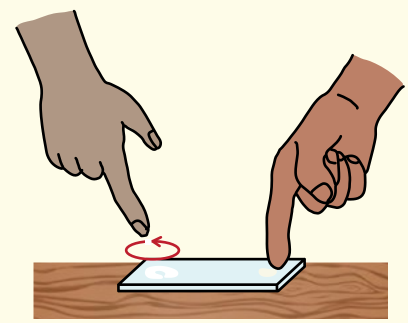


Drops of liquid on inclined glass slides

3. On a clean glass slide, place a drop of Sample 1 and a drop of Sample 2, side by side. Use your forefinger to spread one drop into a small circular smudge by moving your finger at least five times in small circles. Wash and dry your finger before doing the same with the other drop. Look closely. Do the two smudges look the same or different? Describe what you notice.



Drops of milk and curd placed side by side on a flat glass slide



Spreading drops of milk and curd into circular smudges using a forefinger

4. Using a dropper, place a drop of one liquid on a piece of pH paper. Does the colour change? What does this tell you about whether the liquid is acidic, basic, or neutral? If you are using a natural indicator, put a small amount of the liquid into a bottle cap. Add a few drops of the indicator and observe the colour. Repeat the test with the other liquid. Is there a difference in the pH of the two liquids?

5. Record your observations in the table below. You may also draw what you see.

Features	Liquid Sample 1	Liquid Sample 2
Smell		
Thickness (how it flows)		
Appearance of smudge		
pH/indicator colour		
Any other observations		

Think about:

- One sample is milk and the other is curd. Based on your observations, can you identify which is which? What evidence supports your choice?
- Which observation helped you the most in identifying curd: (a) Smell, (b) Thickness/flow, (c) Smudge appearance, or (d) pH? Why do you think this was more reliable than the others?
- Did any observation seem unclear or confusing at first? What helped you decide anyway?
- If two students disagreed about which sample was curd, what further test or observation could help settle the disagreement?

Discuss:

- Are milk and curd different only in how they look and flow? Or are they different in their chemical nature as well? Which of your observations suggest a chemical difference, and why?
- When milk turns into curd, is this change easy to reverse? What does that tell you about the kind of change involved?

Some more questions to think about:

- Would heating milk and curd give the same result? Why or why not?
- If curd is mixed with water, would it behave more like milk? Which properties would change, and which would not?
- Can two liquids look similar but still be chemically different? What evidence from this activity supports your answer?

i wonder... Rediscovering school science

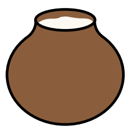
Contributed by:

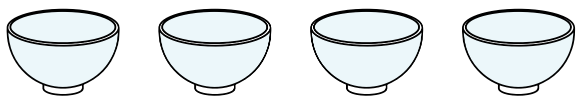
Rohini Karandikar, works as a consultant at TNQ Foundation in Bengaluru, Karnataka. She can be contacted at: rohinikarandikar84@gmail.com.

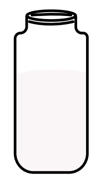
The Science Lab

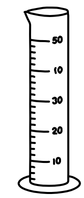
ACTIVITY SHEET II: WHAT CAUSES MILK TO CHANGE TO CURD?

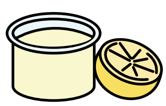
What you will need:

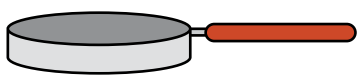

Curd


Four transparent bowls/ beakers of the same volume


Milk


Plastic measuring cylinder

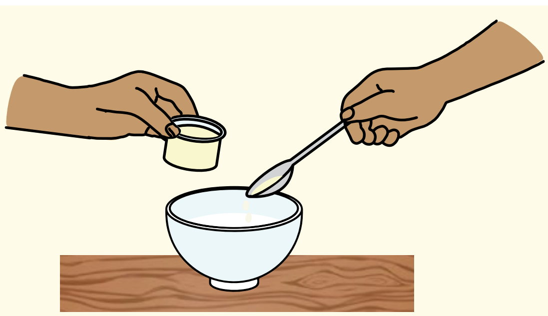

Lemon juice


A small saucepan

What to do:

1. Prepare the materials:
   a) Your teacher will boil the milk and allow it to cool. Gently touch the outside of the container. When it feels warm but not hot, dip a clean finger briefly into the milk. The milk should feel warm, not hot enough to make you pull your finger out quickly. If you have a thermometer, measure and record the temperature. Milk at about 40–45°C is warm enough to make curd.
   b) Boil a small amount of curd in a saucepan (ask your teacher for help). Let it cool completely to room temperature.
2. Set up the experiment: Use the measuring cylinder to pour the same amount of milk into each of the four bowls. Label them Bowl 1, Bowl 2, Bowl 3, and Bowl 4:
   a) Bowl 1: Milk only
   b) Bowl 2: Milk + 2–3 drops of lemon juice

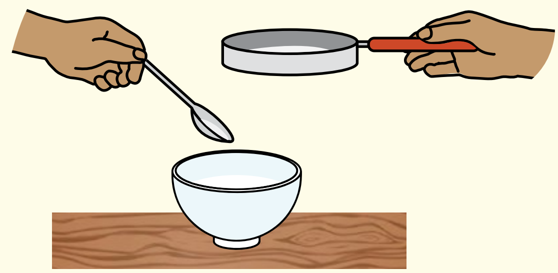

Bowl 1: Milk


Bowl 2: Milk + Lemon juice

c) Bowl 3: Milk + one teaspoon of curd (use a fresh spoon)

d) Bowl 4: Milk + one teaspoon of boiled curd (use a fresh spoon)

Bowl 3: Milk + Curd



Bowl 4: Milk + Boiled curd

3. Mix and wait: Use separate spoons to mix the contents of each bowl gently. Place all four bowls together in a warm place. Do not disturb them.

Observe and record:

Observe the bowls: (a) Immediately, (b) After 4 hours, and (c) After 6 hours. Record your observations in the table below.

Bowl No.	Bowl contents	Time	Did you get curd? Y / N	Any other observations?
1	Milk	Immediately		
		4 h		
		6 h		
2	Milk + lemon juice	Immediately		
		4 h		
		6 h		
3	Milk + a teaspoon of curd	Immediately		
		4 h		
		6 h		
4	Milk + a teaspoon of boiled curd	Immediately		
		4 h		
		6 h		

Think about and discuss:

- Does warm milk change into curd when left to itself? Why or why not?
- What happens to milk when lemon juice is added? How quickly does this change happen? Why does this milk not turn into curd?

- Why does adding a little old curd change milk into fresh curd? What does old curd contain that causes this change? How long does this process take?
- What happens when boiled curd is added to milk? Why does this bowl behave differently from Bowl 3?
- You caused milk to change in three ways: by adding lemon juice, old curd, and boiled curd.
  (a) Which of these changes is reversible? Why?
  (b) Which change took the longest time? Why?
- Why is it important to use fresh spoons for Bowls 3 and 4? What do you think would happen if the same spoon was used first for:
  (a) Old curd and then for boiled curd?
  (b) Boiled curd and then for old curd?
- Have you seen milk spoil at home? How does spoiled milk look and smell? What do you think causes milk to spoil? How is spoiled milk different from curd?
- Some people believe that adding the substances in Column 1 of the table below to milk can make it turn into curd.
  (a) Can you predict which of these is true? Share reasons to justify your predictions.
  (b) How would you test your predictions?
  (c) Do your predictions match your observations? Why?

Additions to milk	Predict: Will curd form?	Test: Did curd form?
Whole red chilli with its separated stalk 		
Whole green chilli with its separated stalk 		
Silver coin 		

Contributed by:

Rohini Karandikar, works as a consultant at TNQ Foundation in Bengaluru, Karnataka. She can be contacted at: rohinikarandikar84@gmail.com.

Chitra Ravi, who works at Azim Premji University, Bengaluru, Karnataka. She can be contacted at: chitra.ravi@apu.edu.in.

EXPLORING NATURAL ACID-BASE INDICATORS: TEACHING EXPERIENCES

SHALOM SUNAINA & MEGHA ARORA

Natural indicators are simple, inexpensive tools for classifying everyday substances as acidic, basic, or neutral. How do we engage students and teachers in a hands-on exploration of familiar and new sources of these indicators?

According to the National Curriculum Framework for School Education (NCF-SE) 2023, one of the goals of the middle-stage science curriculum is to help students develop the ability to classify substances as acidic, basic, and neutral based on their chemical characteristics.[1] Chapter 2 ('Exploring Substances: Acidic, Basic and Neutral') of the latest Grade VII science textbook (NCERT, 2025–2026) defines these categories in terms of the colour change they cause in litmus paper: *"litmus paper is available in two colours—blue and red…substances…, such as lemon juice, amla juice, tamarind water, and vinegar, turned the blue litmus paper to red, implying that these substances are acidic in nature… substances…, such as soap solution, baking soda solution, lime water, and washing powder solution, turned the red litmus paper to blue. Hence, these substances are basic in nature… substances…, such as tap water, sugar solution, and salt solution, did not change the colour of either litmus paper. Can you predict their nature? These substances are said to be neutral because they are neither acidic nor basic."*[2] But many government schools do not have access to litmus paper. Even where it is available, teachers can only afford to use it for demonstrations. To address this limitation, the chapter suggests two other approaches: (a) test edible substances by taste; and (b) test non-edible substances with natural indicators. We share some practical guidelines for exploring the second approach. These are based on our experiences of exploring this theme with students and teachers from Vijayapura, Karnataka and Pithoragarh, Uttarakhand.

A) Introduce the purpose of the exploration:

Students may find the concept of acids and bases abstract. Inviting students to classify edible substances into these categories by tasting them is a simple way of making this concept relatable to them. For example, Chapter 4 ('Acids, Bases, and Salts') of the older Grade VII science textbook (NCERT, 2024-2025) introduces these two categories in the following way: "*Curd, lemon juice, orange juice, and vinegar taste sour. These substances taste sour because they contain acids. The chemical nature of such substances is acidic... What about baking soda? Does it also taste sour? If not, what is its taste? Since it does not taste sour, it means that it has no acids in it. It is bitter in taste. If you rub its solution between your fingers, it feels soapy. Generally, substances like these, which are bitter in taste and feel soapy on touching, are known as bases. The nature of such substances is said to be basic.*"[3] Activity 2.2 in Chapter 2 of the latest Grade VII science textbook (NCERT, 2025-2026) presents students with a list of 11 everyday substances (see **Table I**).[2] Students are asked to consider which of these are edible and can be classified as acids and bases based on taste. Since the list includes non-edible substances such as soap solution, lime (*chuna*) water, and washing powder solution, students recognise the need for other methods of classification. For example, when asked why taste alone is insufficient for this purpose, a Grade VII student from Pithoragarh reasoned that some substances are too harmful to touch or taste. But knowing whether they are acidic or basic can help us handle them safely.

S. No.	Substance	Edible or not?
1	Lemon juice	
2	Soap solution	
3	Gooseberry (*amla*) juice	
4	Tamarind water	
5	Vinegar	
6	Baking soda solution	
7	Lime (*chuna*) water	
8	Tap water	
9	Washing powder solution	
10	Sugar solution	
11	Salt solution	

Table I. A list of 11 everyday substances to classify as acids or bases. This list is included in Activity 2.2 in Chapter 2 of the latest Grade VII science textbook (NCERT, 2025-2026).[2]

B) Emphasise the need for hands-on experience:

Both Chapter 4 of the older Grade VII science textbook (NCERT, 2024–2025) and Chapter 2 of the latest Grade VII textbook (NCERT, 2025–2026) suggest some commonly available sources of natural indicators and simple, inexpensive methods for preparing them.[2, 3] Ankita Chaturvedi shares other sources and similar processes in 'Teacher's Guide I: Extracting potential natural indicators' (i wonder..., Apr 2025).[4] Her methods—chopping, mashing, steeping, and straining—are used in kitchens everyday. Yet many students and teachers only read about indicators. Students in Pithoragarh reported that they had never prepared or used any indicators, and teachers in both Vijayapura and Pithoragarh shared that they had been unable to try these activities in class.

It is important to emphasise the need for students and teachers to engage in hands-on experiences around this theme. One of the authors did this by narrating a personal anecdote to a group of government school teachers from Vijayapura. While preparing for a class, she asked her son to collect periwinkle flowers. Watching her prepare an extract and test it with lemon juice and soap water sparked his curiosity. He began bringing

S. No.	Known sources of natural indicators	Where do students/ teachers read about it?
1	Turmeric root	Chapter 4 of the Grade VII science textbook (NCERT, 2024-2025)
2	China rose flowers	
3	Lichens	
4	Red rose flowers	Chapter 2 of the latest Grade VII science textbook (NCERT, 2025-2026)
5	Beetroot	
6	Indian blackberry (*jamun*) fruit	
7	Red/purple cabbage	
8	Purple yam	Ankita Chaturvedi's 'Teacher's Guide II: Colour Change in Natural Indicators' (i wonder..., Apr 2025)
9	Red bell pepper	
10	Red spinach leaves	
11	Strawberry fruit	
12	Pomegranate peels and seeds	
13	Black grapes	

Table II. A list of 13 'known' sources of natural indicators.[2, 3, 5] Shalom Sunaina shared this list with the teachers in Vijayapura.

other flowers (like roses and wildflowers) to test, eager to see what colour changes they would produce. Although some extracts produced unclear results, his enthusiasm was undamped. The author used this experience to highlight how natural indicators can spark genuine curiosity and self-driven exploration in children. Teachers were encouraged to offer students similar opportunities, either in school or at home (if time in class was a constraint). A few of the teachers later reported having tried this.

C) Begin from the textbook:

Many teachers might prefer starting hands-on work with sources recommended in textbooks. For example, after learning that none of the teachers she was working with had prepared indicators, one author shared Ankita Chaturvedi's Teacher's Guide II: Colour Change in Natural Indicators (i wonder..., April 2025).[5] Her aim was to inspire the teachers by highlighting the many sources of natural indicators that Ankita had experimented with. In the following session, she learned that all the teachers had prepared indicators using turmeric and China rose—the two sources listed in Chapter 4 of the Grade VII science textbook (NCERT, 2024–2025).[3] None had explored any other sources.

In such cases, beginning with the textbook can help teachers build confidence in working with their hands. Teachers and students can then be encouraged to modify methods or explore new sources. For example, the teachers in Vijayapura went on to prepare indicators by modifying textbook methods in small ways:

- Indicator solutions: While the textbook recommends filtering the coloured extract produced by 'steeping' China rose flowers in hot water, the teachers boiled them.[3] They also prepared a solution by mixing turmeric powder with water.
- Indicator strips: The textbook suggests rubbing 'turmeric' paste on 'filter' paper before drying it and cutting it into thin strips.[3] The teachers used plain paper and made strips with a paste of China rose flowers, too.

D) Encourage exploration of local sources:

A common challenge reported by students and teachers was the local or seasonal unavailability of some known sources of indicators (see **Table II**). For example, students in Pithoragarh had not seen lichens near their school or homes. The teachers in Vijayapura reported that red cabbage and purple yams were not locally available. Although strawberries were available in November and December, they were unavailable at the time of this discussion (July). Although the teachers believed that red bell peppers might be available in certain shops, they had not seen them in the local markets where they bought their produce. In such cases, students and teachers can be encouraged to think about sources that are locally and seasonally available to them. For example, the teachers in Vijayapura extracted indicators from beetroot, pomegranate, and grapes—all of which are locally grown and readily available to them throughout the year.

The unavailability of known sources of natural indicators can also be used to encourage students and teachers to discover new sources. This can engage their natural curiosity and observation skills. For example, when given this opportunity by their teachers, some Grade VI and VII students from Vijayapura prepared extracts from wildflowers that were in bloom at the time, even though they did not know the plants' names. Some of their teachers, too, experimented with these wildflowers. In addition, they tested extracts from some new but familiar sources like coffee and neem. In some cases, it might be helpful to draw attention to a specific source. For example, since the teachers from Vijayapura had expressed a preference for exploring local produce, one author suggested testing extracts from the dragon fruit grown in the region.

E) Emphasise caution while handling unsafe or unknown plants:

Children can be very curious about plants in their surroundings. But some local plants may not be safe to handle. For example, a student in Vijayapura tested oleander (called *kanagli* in Kannada) flowers; unaware that all parts of this plant are highly toxic and contact with its sap can cause skin irritation. Similarly, Grade VII students from Pithoragarh suggested testing stinging nettle (*Urtica dioica*) as a potential source. When asked why, the students explained that they had seen the plant growing near their school and had long been curious about it. They had heard that touching the plant—locally known as *Bicchu ghaas*—causes a stinging sensation. For this reason, students associated the plant with having a 'strong' or 'chemical-like' nature. They reasoned that because it produces a noticeable reaction on the skin, it might contain substances that react differently with acidic and basic solutions.

To reduce risk, teachers should insist that students discuss any new source before investigation. Toxic plants should be avoided, and unfamiliar plants should be researched and handled only by teachers using appropriate precautions. Students must also be reminded to:

- Never taste or eat substances used in explorations
- Wash hands thoroughly with soap and water after each exploration, and
- Conduct such explorations at home or school only under adult supervision.

F) Use discussion to support learning and further exploration:

Through discussion, one of the authors learnt that some of the teachers in Pithoragarh that she worked with hesitated to explore indicators in class mainly due to limited resources and concerns about procedural accuracy. She emphasised that the value of these activities lies not in perfect laboratory conditions, but in supporting students' ability to observe, think, and question. She also shared how important it was to allow students to decide not only the source they want to explore, but also the methods they use for it. For example, in one classroom, she observed that students divided a plant extract into two cups and added lemon juice to one and detergent solution to the other (see **Fig. 1**). The first solution turned red in colour and the second turned blue. Procedurally, this approach can raise some concerns, particularly regarding the ratio of indicator volume to the test solution. The usual recommendation is to add indicators in small amounts to the solution being tested, as this reduces the likelihood of errors arising from the weak acidic or basic properties of the indicator itself. But the author recognised that the students had adopted this approach simply to *"see what happens."* Keeping this in mind, she began the post-activity discussion by emphasising that indicators produce observable and distinct colour changes in acidic and alkaline substances. She then explained the importance of—and the reasons for—adding the smallest possible volume of indicator (gradually, in drops) to test solutions, in order to minimise experimental error.

The other author introduced the teachers in Vijayapura to the process of extracting and testing indicators by demonstrating the procedure and discussing each step in detail. This encouraged many of the teachers to prepare and test some indicators

Fig. 1. Testing plant extracts for the presence of indicator properties. Students from Pithoragarh, Uttarakhand, tested new plant extracts with lemon juice and a detergent solution. Note: The facial features of a student in the background has been blurred to protect their privacy.

themselves (see **Table III**). It also motivated some of them to try this approach with their students. For example, one teacher assigned this activity as homework for her students and supported their exploration through discussion in the following ways:

- **Before the activity**, the teacher shared clear instructions about suitable sources and methods. She suggested some common and easily available fruits and flowers that students could start with, and explained how indicators could be prepared at home by crushing the source material in a small amount of room-temperature water. Students were instructed not to try boiling water on their own, and to carefully record all their observations and questions.
- **After the activity**, the teacher invited students to share their observations and questions in class. Many students had tested their indicators on household products such as shampoo, coffee decoction, bathing soap, and washing soap. One challenge they reported was that indicators did not always produce a clearly visible colour change. For example, when an indicator was added to dark brown coffee decoction, students found it difficult to detect any change in colour. Another challenge was interpreting the observations. Each indicator produced a different type of colour change in different test solutions, and students were unsure how to use these changes to classify the household products as acidic or basic.

S. No.	Source of indicator	Colour change in a known acid	Colour change in a known base
1	Turmeric	Yellow	Reddish-brown
2	Oleander	Pink	Greenish
3	China rose	Red	Green
4	Periwinkle	Pink (dark)	Greenish (dark)
5	Neem	Colorless	Light yellow
6	Coffee solution	Dark brown but not distinguishable	No change
7	Red Rose	Deep red	Green
8	Wildflower growing in a neighboring field (name unknown)	Colorless	Greenish
9	Onion	Retains smell	No smell
10	Beetroot	No specific change observed	No specific change observed

Table III. A record of the results that Grade VI–VII teachers from Vijayapura observed on testing plant extracts for their ability to act as acid-base indicators.

Interestingly, students also reported that extracts prepared from both white and pink periwinkle flowers produced the same type of colour changes in the test solutions. To address these difficulties, the teacher suggested that students begin by testing their indicators with substances whose nature they already knew to be acidic or basic, such as lemon juice, tamarind extract, soap solution, and lime water. She also shared a modified version of Table 4.3 from Chapter 4 of the Grade VII science textbook (NCERT, 2024–2025) and asked students to record their observations using this format (see **Table IV**).[3] When students continued to find the results confusing, the teacher explained that: (a) many natural indicators show different colour changes at different pH values, and (b) different indicators may produce different colours in the same substance. She then repeated the activity in class, allowing students to use litmus paper to classify the test samples as acids or bases. This helped students appreciate that litmus paper produces more distinct and reliable colour changes. They also learned that while natural indicators are valuable tools for exploration, they may not always yield accurate results. The teacher used this exercise to highlight how litmus paper provides a simple and reliable way to link colour change with the acidity or alkalinity of a substance.

G) Encourage reflection on connections with the textbook and everyday life:

Our first recommendation is to begin with a discussion on the purpose of exploring natural indicators (as simple, low-cost tools to classify substances as being acidic, basic, or neutral). Our

S. No.	Test solution	Effect on turmeric solution	Effect on China rose solution	Effect on other indicator (specify name)	Remarks
1	Lemon juice				
2	Orange juice				
3	Vinegar				
4	Milk of magnesia				
5	Baking soda				
6	Lime water				
7	Sugar				
8	Common salt				

Table IV. A table that a teacher in Vijayapura shared with her students. This is a modified version of Table 4.3 from Chapter 4 of the Grade VII science textbook (NCERT, 2024-2025).[3]

Fig. 2. Exploring a 'fun' application of natural indicators. Students from Vijayapura, Karnataka, created and displayed a welcome message on turmeric paper. This is 'revealed' on spraying a baking soda solution. Note: The facial features of one of the children has been blurred to protect their privacy.

last recommendation is to end with a discussion on the relevance of this classification:

- For students: It can be useful to link these discussions to aspects of the exploration that students themselves show interest in. For example, after a group of Grade VII students from Vijayapura determined that coffee decoction was acidic in nature, their teacher invited them to consider what effects drinking it in excess could have on their health. In another case, participating in this exploration led a Grade VII student from Pithoragarh to reason that ENO (the brand name of a commonly used antacid) must be basic in nature, explaining: *"We use it when we have acidity in our stomach."* To illustrate a direct and engaging application of this learning, some of the teachers in Vijayapura encouraged students to use natural indicators to create and display secret messages during the annual *Kalika Habba*, an exhibition of students' learning and science day celebrations (see **Fig. 2**). Students enjoyed this activity, and it helped them appreciate the relevance of the exploration in a different and more playful way.
- For teachers: It may be helpful to connect this exploration with other topics in the middle-stage science curriculum. For example, in discussions with teachers from Vijayapura, one of the authors pointed out that the methods used to extract natural indicators—described by Ankita

Box 1. Curricular connections:

Activities and discussions around this exploration with natural indicators can help meet the following:

A) Curricular goals for middle-stage science:

- CG-1: [The student] explores the world of matter and its constituents, properties, and behaviour. Specifically, it can support students in developing the competency (C-1.1) to: *"Classify matter based on observable... chemical (pure, impure; **acid, base**; metal, nonmetal; element, compound) characteristics."*
- CG-6: [The student] explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, it can support students in developing the competency (C-6.2) to: *"Formulate questions using scientific terminology (to identify possible causes for an event, patterns, or behaviour of objects) and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments)."*
- CG-7: [The student] communicates questions, observations, and conclusions related to science. Specifically, it can support students in developing the competency (C-7.1) to: *"Use scientific vocabulary to communicate science accurately in oral and written form, and through visual representation."*[1]

B) Learning outcome for Grade VII science: [The student] conducts simple investigations to seek answers to queries like: *'Can the extract of coloured flowers be used as acid-base indicators?'*[9]

Chaturvedi in her article 'Exploring Acids & Bases with Natural Indicators' (i wonder..., Apr 2025)—are the same methods that students are expected to learn in Chapter 9 ('Methods of Separation') of the Grade VI science textbook (NCERT, Reprint 2025–2026).[6, 7] For example, when students observe a teacher extracting an indicator from China rose, they see the flowers being boiled in water (sometimes to reduce excess water and obtain a more concentrated solution) and the solution being filtered. These steps can be related to the processes of evaporation and filtration. In contrast, when indicators are extracted from wildflowers without boiling, students crush the flowers, soak them in water, and then filter the solution. These steps can be linked to decantation and filtration. To support such connections, the author suggested that teachers ask guiding questions such as: *How do we prepare a natural indicator? What steps are involved? Which separation methods are used in this process?* Teachers who tried this approach reported that it made it easier for them to explain the key concepts in Chapter 9 of the Grade VI science textbook (NCERT, Reprint 2025–2026).[7] The same author also drew teachers' attention to the fact that the colour changes produced by indicators can be linked to the concept of chemical changes introduced in Chapter 5 ('Changes Around Us: Physical and Chemical') of the Grade VII science textbook (NCERT, 2025).[8] One teacher shared this connection in her classroom by explaining that the colour change observed when an indicator is added to an acid or a base results from a chemical reaction, rather than simple physical mixing. She reported that this example helped students relate to the idea of chemical changes in a more visual and concrete way.

Parting thoughts

Involving students in the exploration of natural indicators can help teachers address multiple curricular goals of middle-stage science (see **Box 1**).[1] Such activities can spark students' curiosity and strengthen their understanding of how science operates in everyday contexts. Another important outcome is the development of a scientific temperament. Through these explorations, students learn to observe carefully, make predictions, and draw evidence-based conclusions. This enables them to learn science by doing rather than by memorisation, leading to deeper conceptual understanding. In addition, students feel more respected and confident in sharing their ideas, helping to create a positive and supportive classroom environment.

Key takeaways

- An important curricular goal of the middle-stage science curriculum is to help students classify everyday substances as acidic, basic, or neutral. Natural indicators act as simple and inexpensive tools for classification.
- Allowing students and teachers to begin their exploration of natural indicators from sources listed in the textbook can help build their confidence.
- In preparing indicators, prioritising hands-on experience over procedural precision can give students and teachers the opportunity to observe, think, and question.
- Using seasonal or local constraints in indicator sources as opportunities for discovery of new sources can engage students' and teachers' curiosity in local plants.
- Discussions before and after exploration can help address misconceptions, examine procedural choices, and deepen understanding.

Acknowledgments:

The examples of practice shared in this article were first provided by Shalom Sunaina and Megha Arora in separate responses to a request by Shiv Pandey for feedback on earlier issues of i wonder... Additional details were later shared by email with Radha Gopalan and Chitra Ravi. These experiences have been brought together, reframed, and compiled into this article by Chitra Ravi. The i wonder... team thanks the authors for generously sharing their experiences and for their permission to present them in this form.

Notes:

Credits for the image (Extracting indicator from periwinkle flowers) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

References:

1. National Steering Committee for National Curriculum Frameworks (2023). 'National Curriculum Framework for School Education 2023'. National Council of Educational Research and Training. URL: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf.
2. National Council of Educational Research and Training (2025). 'Chapter 2: Exploring Substances: Acidic, Basic, and Neutral'. Curiosity, Textbook of Science for Grade VII: 7-22. URL: https://ncert.nic.in/textbook.php?gecu1=2-12.
3. National Council of Educational Research and Training (2024). 'Chapter 4: Acids, Bases, and Salts'. Curiosity, Textbook of Science for Grade VII: 38-46. URL: https://www.ncert.nic.in/textbook/pdf/gesc104.pdf
4. Chaturvedi, Ankita (2025). 'Teacher's Guide I: Extracting potential natural indicators'. i wonder... (12): 72. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6057/.
5. Chaturvedi, Ankita (2025). 'Teacher's Guide II: Colour change in natural indicators'. i wonder... (12): 73-74. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6058/.
6. Chaturvedi, Ankita (2025). 'Exploring acids & bases with natural indicators'. i wonder... (12): 68-71. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6055/.
7. National Council of Educational Research and Training (Reprint 2025-2026). 'Chapter 9: Methods of Separation in Everyday Life'. Curiosity, Textbook of Science for Grade VI: 163-181. URL: https://ncert.nic.in/textbook.php?fecu1=9-12.
8. National Council of Educational Research and Training (2025). 'Chapter 5: Changes Around Us: Physical and Chemical'. Curiosity, Textbook of Science for Grade VII: 57-72. URL: https://ncert.nic.in/textbook.php?gecu1=5-12.
9. National Council of Educational Research and Training. 'Learning Outcomes at the Elementary Stage'. First Edition. National Council of Educational Research and Training (2017). URL: https://ncert.nic.in/pdf/publication/otherpublications/tilops101.pdf.

Shalom Sunaina has been working as a Resource Person at Azim Premji Foundation, Vijayapura, Karnataka, since 2023. In this role, she supports Science, English, and Mathematics education in government schools. Before this, she worked as a Physics Lecturer for 11 years in pre-university and degree colleges. She also worked as an Academic Specialist at Byju's for a year. Shalom can be contacted at: shalom.sunaina@azimpremjifoundation.org.

Megha Arora is a Resource Person at Azim Premji Foundation, Pithoragarh, Uttarakhand. She joined the Foundation in 2022 as an Associate Resource Person. Megha enjoys facilitating teacher workshops on the pedagogy of science and mathematics. She can be reached at: megha.arora@azimpremjifoundation.org.

DID YOU KNOW?

DISCOVERY CAN BE RISKY—THAT IS WHY SCIENTISTS LEARN TO BE CAREFUL

Science is driven by curiosity—the urge to observe, test, and understand the world more deeply. Many discoveries we rely on today were made at a time when scientists knew far less about the risks involved in studying living organisms, materials, or natural phenomena. In these early stages of scientific exploration, safety knowledge developed slowly. As a result, some scientists were injured or fell ill—not because they were careless, but because the dangers were not yet understood.

For example, in 1900, physician Jesse William Lazear was studying yellow fever. To investigate whether mosquitoes spread the disease, he allowed himself to be bitten by an infected mosquito. He later died from yellow fever. His work, together with that of his colleagues, contributed to understanding the transmission of the disease, which over time led to improved public health measures. In 1932, researcher William Brebner was bitten by a rhesus monkey while working with animals. He died from an infection later identified as the B virus, a pathogen that can spread from monkeys to humans. Research following this case improved knowledge of zoonotic diseases and laboratory safety procedures. Not all encounters were fatal. In 1933, doctor Allan Walker Blair deliberately allowed a black widow spider to bite him to observe the effects of its venom. Though he experienced severe pain, he survived, and his careful observations contributed to medical understanding of spider bites. Similarly, herpetologist Karl Patterson Schmidt was bitten by a venomous snake in 1957 while studying reptiles. He recorded his symptoms in detail, providing useful information about the effects of snake venom. Scientists also faced risks while studying materials that seemed harmless. In the 18th century, chemist Carl Wilhelm Scheele handled and, in some cases, tasted substances such as mercury, arsenic, and lead, before laboratory safety rules existed. Repeated exposure damaged his health and contributed to the later establishment of strict safety practices in chemistry.

These stories are not meant to frighten students. They show how scientific knowledge develops through observation, evidence, and careful recording, and how safety has become an integral part of scientific practice. Modern laboratory rules—using gloves, labels, careful handling, and supervision—are based on generations of experience and understanding of chemical, biological, and physical hazards. When students investigate plants, soil, water, or household materials, these examples help teachers frame caution as responsible curiosity. They also support discussions about how scientists decide what can be observed safely, what requires protective measures, and what should be avoided entirely.

Question for students: You already investigate the world every day—touching plants, mixing substances, heating food, or fixing things.

- Which of these activities could be risky if done carelessly?
- How do adults reduce these risks?
- If you were planning a classroom investigation, what safety steps would you include—and why?

WHEN DO 'FLOATING' AND 'SINKING' SURPRISE US?

VIJETA RAGHURAM & CHITRA RAVI

In much of school science, we often rush from 'seeing' to 'explaining,' and sometimes skip the 'seeing' part altogether. For example, Chapter 7 ('How Things Work') of the Grade IV EVS textbook (NCERT, 2025-2026) suggests an investigation into floating and sinking.[1] Yet, we often let memorised textbook facts and remembered childhood stories settle this investigation for us. Take the well-known fable of the thirsty crow: it finds a pitcher of water, but the level is too low for it to reach. It cleverly drops pebbles into the pitcher until the water rises high enough for it to drink.[2] Because we know this story so well, conclusions like *"stones sink"*, *"leaves float"*, and *"dropping objects that sink into water can raise its level"* seem so obvious that we think of them as rules.[3] We assume that these rules tell us how 'all' objects will behave, so we see no need to actually test them.

Here is a puzzle that invites you to test your assumptions. Imagine you are the crow, looking for objects that can raise the water level enough for it to be within your reach.[4] Around you are many different everyday objects (see **Table I**). We invite you to start by predicting how these objects will behave, and then test your predictions. Use this to identify surprises and reflect on how—and why—your understanding of floating and sinking changes in response. The goal here is not to be right; it is to become aware of what we notice and what we miss when we do not try things out for ourselves.

A) Choose the container: The crow did not have a choice. But you do. What kind of container would make it easier for you to observe small changes in the level of water? A tall and narrow container or a short and wide one? Straight sides or sloping ones? Transparent or opaque? Which of these features matter most and why?

B) Map ideas to objects: Before you look at the objects, pause and ask yourself: *What must be true of an object for the crow's method to work?* List as many conditions as you can think of. Try not to name objects; instead describe **properties** or **behaviours**. For example, what shape and size would make it difficult to fit an object into the container? Does the object need to sink to the bottom of the container, or can it stay just a little below the surface? Would it need to actively push water aside or can it rest lightly on top? What if it soaks up water, breaks apart, or dissolves instead of holding its form over time? Keep in mind

A wooden stick	A piece of dry sponge	One small piece of thread
A piece of bread or *roti*	A crumpled ball of paper	Some puffed rice
The cap of a water bottle	Some pieces of *kopra* (dried coconut)	One plastic ball
One small wooden pencil	A biscuit	10 metal paper clips
Chalk pieces	An assortment of buttons	A matchbox without matches
Some fresh and dry leaves	A flat piece of aluminium foil	Some ripe *jamuns* (the fruit)
One small uncapped empty cold drink bottle	A small, tightly capped cold drink bottle with some juice.	A handful of moong *dhal* seeds
A sharpener	A piece of Thermocol (polystyrene foam)	One glass bangle
A handful of groundnuts with shells	Some coins	Some flowers
A used piece of soap	A raw egg	A small lump of clay

Table I. Objects you can drop into the water. Some sink, some float, some absorb water, and some change over time.

that labels like 'heavy,' 'sinking,' or 'made of stone' do not automatically answer these questions.

C) Commit to predictions: Once you have listed your conditions, think about which everyday objects might best satisfy these conditions (see **Table II**). Without testing them yet, answer the following questions:

- Which five objects would you choose **first** if your aim was to raise the water level as quickly as possible?
- Which three objects do you feel most unsure about, but are curious to test?
- Which objects look very different from each other, but you think might behave in a similar way in water?

Notice which choices you feel confident about, and which ones are just guesses.

D) Test your predictions: Gently put one object at a time into the water in your chosen container. Watch not only where the object goes in the first few seconds, but also if this changes over the next few minutes. As you test, keep asking yourself: Which predictions were correct, and which ones changed? What did I notice only after I tested my predictions? Which observations were the most surprising?

E) Change the liquid: What if you replaced tap water with a different liquid? For example, can you predict what would change if you used: (a) Salt water (how much salt would you add?), (b) Sugar solution (how much sugar would you add?), (c) Fresh lemon juice, (d) Bottled fruit juice, and (e) Milk? Using the same objects, which liquid would show the maximum rise? Can you think of another everyday liquid that might show an even greater rise? Do you think any objects in Table I might behave differently in these liquids—if so, why? If you tested these ideas, what observations would surprise you the most?

F) A boundary case to notice: Before drawing any conclusions, try this with a fresh container of water. Gently place a dry needle right on top of the water's surface. Notice what happens. Then, place a second needle (of the same kind) on a small piece of tissue paper and lower it carefully into the water. Watch what happens as the tissue paper gets soaked and sinks. Do the two needles behave the same way? Look closely at the water under the second needle. Is it actually floating, or is something else holding it up? What did the tissue paper do for the second needle that your fingers could not do for the first one? Notice how our usual ideas about 'floating' and 'sinking' do not quite fit what we see here. You do not need to fully explain this 'difference' yet. This is just a reminder that some observations can strain our categories.

G) Reflect: We often remember puzzles like this because of what surprised us. But their

S. No.	What to think about	Which objects (~2-4) from Table I might fit this?	Make a brief note on why you think so.
1	**Shape matters**: The same material could behave differently if its shape changes (flat, crumpled, hollow, compact).		
2	**Trapped air**: The object may carry air into the water at first, even if it later sinks or changes.		
3	**Absorption and change over time**: The object may soak up water, swell, soften, or break apart.		
4	**Placement and balance**: How the object is placed (gently, tilted, dropped) may affect what happens.		
5	**Same material, different behaviour**: Objects that seem similar in material may not behave similarly in water.		
6	**"Feels heavy"**: Objects that are heavy enough to sink, but still surprise you in how they affect the water level.		

Table II. Concept–object mapping. The second column lists some examples of object properties that might affect the water level. Add your own conditions to this list, or create your own. Do not test the objects yet; use this table to commit to your predictions before looking at the physical evidence.

real value comes from what they make us think about afterward. Look back at your predictions, observations, and surprises. Then, think about:

- What mattered most in your observations: the material of the object, its size and shape, or what it did once it entered the liquid?
- Did sinking always mean the object was 'useful' for raising the water level? Did floating always mean it was 'not useful'?
- If your prediction was different from what you observed, did you revise your explanation to fit what you observed? Or did you check whether your observation was affected by an error or limitation? Explain your thinking.

It is in reflecting on these questions that our observations turn into understanding.[3] When we pause to examine our own predictions, hesitations, and revisions, we practice the kind of thinking we ask students to do—but rarely give ourselves time for. With your classroom in mind, consider these:

- If a student made the same predictions you did, what would they need help noticing?
- How often do we expect students to make predictions based on careful reasoning without first giving them time to try things out, observe, wait, and adjust their ideas?

Parting thoughts

This puzzle mirrors the thinking we want students to practice: predicting, observing, and revising ideas rather than relying on assumptions. By trying it ourselves, we uncover hidden details, identify surprises, and refine our reasoning—just as students need to. It helps us anticipate misconceptions, scaffold observations, and ask students questions that deepen their understanding. Rather than being separate from classroom practice, this puzzle is a rehearsal for noticing, guiding, and supporting inquiry in real student investigations.

Notes:

(a) Credits for the image (Everyday objects for investigation, scattered on floor) used in the background of the article title: Created for i wonder... using ChatGPT, under prompting by Chitra Ravi (Dec 2025). License: CC BY-NC-ND.

(b) The order in which the authors' names and bios appear reflects the sequence in which contributions were made to this article. The author who made the first substantial contribution is listed first, and the author who made the final contribution is listed last. Unlike in academic articles, this order does not indicate the relative amount, importance, or value of each author's contribution.

References:

1. National Council of Educational Research and Training (2025). 'Unit 4: Things Around Us.' Our Wondrous World, Textbook of EVS (The World Around Us) for Grade IV: 102-103. URL: https://ncert.nic.in/textbook.php?deev1=7-10.
2. Yadav, Manish (2021). 'Fun with Archimedes' principle'. i wonder..., 6: 20-23. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/2844/.
3. Sharma, Anshika (2025). 'Experiencing how things work'. i wonder..., 13: 39-47. ISSN 2582-1636. URL: https://publications.azimpremjiuniversity.edu.in/6328/.
4. Classic Aesopica. (n.d.). 'The crow and the pitcher'. URL: https://www.classicaesopica.com/crow-and-pitcher. Accessed on: Dec 30, 2025.

Vijeta Raghuram works at Azim Premji University, Bengaluru. She can be contacted at: vijeta.raghuram@apu.edu.in.

Chitra Ravi works at Azim Premji University, Bengaluru. She can be contacted at: chitra.ravi@apu.edu.in.

DID YOU KNOW?

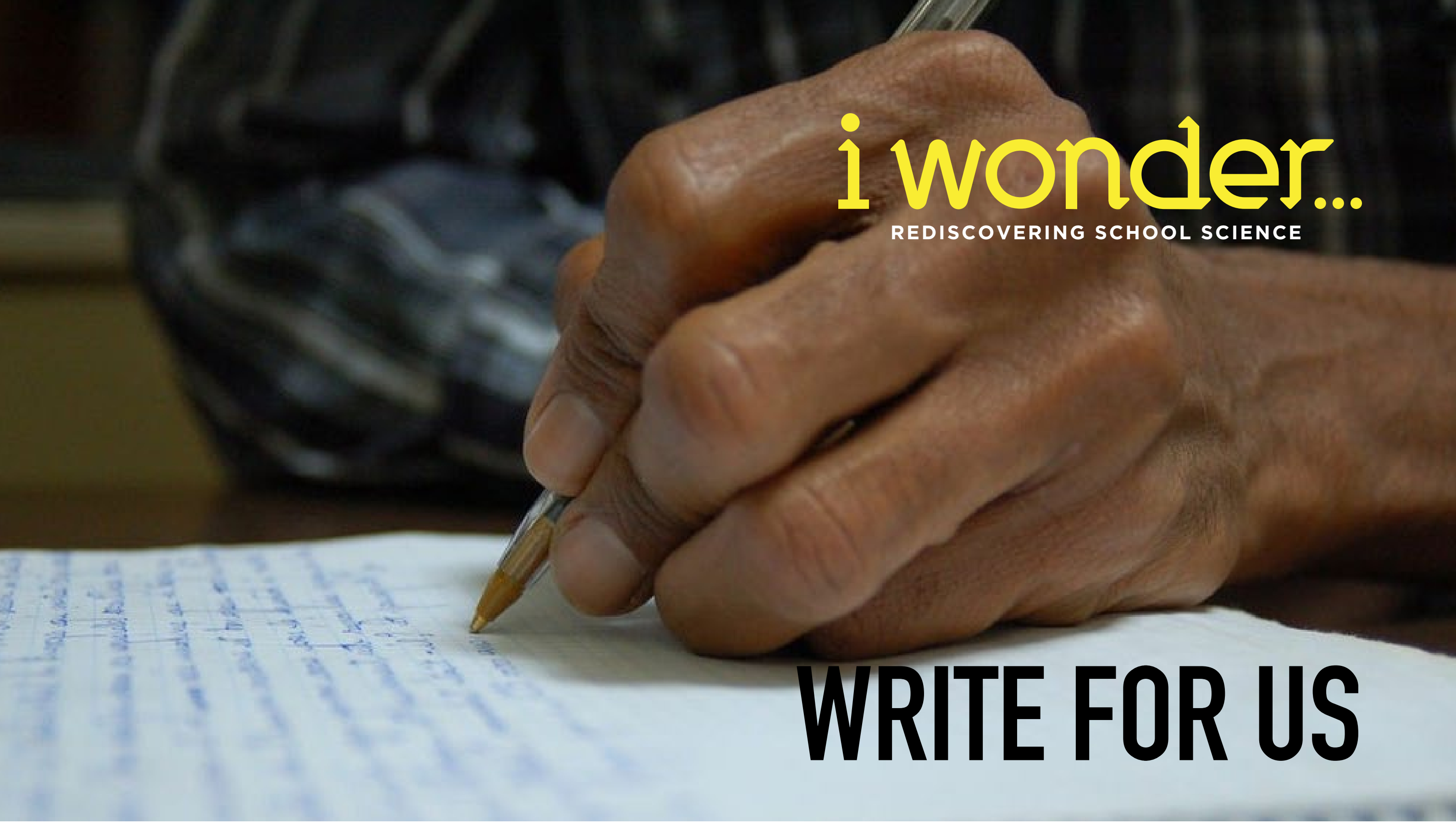
HOW SINKING AND FLOATING PROPERTIES MATTER

Did you know that the simple question "Will this sink or float?" helps people design boats, keep swimmers safe, clean polluted water, and improve everyday food practices? The science behind sinking and floating is not limited to classroom tubs of water. It is quietly at work all around us, shaping technologies, safety measures, and daily activities.

When an object is placed in water, scientists explain what happens in two connected ways. One is by comparing the object's mass to its volume, a property called (average) density. The other is by comparing forces: the downward pull of gravity on the object and the upward push of water on it, called the buoyant force. Scientists study sinking and floating by measuring mass and volume and by observing how objects behave in water under different conditions. Over time, repeated tests, careful comparisons, and shared observations have built strong evidence for how floating works. Consider boats. A huge ship made of steel floats, while a small steel nail sinks. This does not mean that metal always floats or always sinks. Experiments show that boats float because their shape allows them to displace a large volume of water, which lowers their average density compared to water. Many boat designs also trap air, increasing volume without much increase in mass. Shipbuilders test different designs in water tanks before building real ships. Designs that sink are modified or rejected—evidence comes first, decisions follow. Water itself also matters. Many people notice that floating feels easier in the sea than in a river or pond. Experiments show that salt water is denser than fresh water. For the same person in the same position, denser water provides a greater buoyant force, making floating easier. Scientists have measured this effect in many water bodies, including the Dead Sea, where floating is especially easy. Knowledge of floating is essential for safety. Life jackets contain materials such as foam that trap air, increasing a person's total volume without much increase in mass. Tests show that this helps keep people afloat, and designs are improved through repeated testing in different conditions. The same ideas appear at home. When rice or *dhal* is washed, husks and damaged grains often float because they have lower average density, while healthy grains sink. Oil floating on water is another example, used during oil-spill clean-ups to skim oil from the surface through careful observation and testing.

All these examples show that sinking and floating are not about guessing. They depend on careful observation, testing under varied conditions, and using evidence to explain what happens.

Question for students: Take a bowl of water and a small ball of dough from your kitchen. Place the ball of dough gently in the water and observe for a full minute. Does it sink quickly, slowly, or change as it becomes wet? Using the same dough, without adding or removing any material, reshape it in three ways—for example, a tight ball, a flat sheet, and a hollow form with air inside. Test each shape one at a time. Each time, note how fast it sinks or floats, which part touches the water first, and whether its behaviour changes with time. Ask yourself: What changed—the dough, the water, or the space the dough occupies? How might trapped air or spreading the dough affect the water's push? If you could not use words like 'sink' or 'float,' how would you describe what you observed? What test would make your explanation stronger?



WRITE FOR US

i wonder... is a magazine for preparatory-stage (Grades III-V) Environmental Studies (EVS) and middle-stage (Grades VI-VIII) science teachers. Our aim is to share articles and resources that government school teachers can use in classroom instruction.

Requirements:

What kind of subject knowledge, pedagogical approaches, and perspectives to school education would teachers need to meet grade-appropriate curricular goals and build related competencies in their students? If you are a practicing science teacher, teacher educator, or researcher engaged in exploring this question, share your experience with us.

1. Choose a topic from the latest edition of the preparatory-stage EVS and middle-stage science textbooks (NCERT, 2024-2025). These are freely available here: https://ncert.nic.in/textbook.php. Highlight explicit connections to the content of these chapters. Allow the grade-appropriate learning outcomes for these subjects to guide the scope, complexity, and level of abstractness of your draft.
2. The National Curriculum Framework for School Education (NCF-SE) 2023 recommends specific curricular goals for preparatory-stage EVS and middle-stage science education. This document is freely available here: https://education.gov.in/sites/upload_files/mhrd/files/ncf_2023.pdf. Teachers are expected to meet these goals in ways that help their students develop and practice certain competencies in their real world. Present your article and/or resource from a perspective that supports teachers in this task.
3. Context plays an important role in what teachers can do in their class. Where possible, share how teachers can apply or adapt your article or classroom resource to meet the requirements and constraints of their own contexts. Design activity ideas and teaching guides with materials that government school teachers and students can find easily, locally, and inexpensively.

Your submission:

- Needs to be original. Include references and acknowledgements to indicate contributions from others.
- Needs to be as concise as you can it. It can be as short as 800 words. Try not to exceed 1500 words.
- Needs to be written in simple non-academic language. Do show us why the ideas in your draft matter to you.

Share your pitch with us:

Write a brief outline that tells us what you want to write about and the key questions you intend to address. Also, tell us how your article:

- Supports the content of the grade-appropriate NCERT textbook.
- Aligns with the stage-appropriate curricular goals in the NCF-SE 2023.
- Can be used by teachers in their classroom instruction.

Include a brief bio (< 50 words) that tells us something about your background in science and/or science education, and areas of interest in school science.

Send your pitches and drafts to: iwonder@apu.edu.in. We accept submissions (in English, Hindi, or Kannada) throughout the year.

FEEDBACK FROM READERS

"The article 'Exploring the Sun's path with Stellarium' has given new insights as I have used the mobile app. But now I can plan in a better way with students and teachers.. [The] article 'Pedagogy of Making: Pinhole Camera'... connects with other angles of providing opportunities to students to... solve problems through models and discuss different aspects. Lavanya Karthik's book looks nice and I got information about such creative representation of scientists' work through her article 'Introducing an Indian Scientist: Janaki Ammal'. I found that right now the magazine is a mixture of different levels. For example, the articles 'Pedagogy of Making: Pinhole Camera' by Shiv Pandey, 'Doing Science without Labs' by Satish, and Exploring Acids & Bases with Natural Indicators' by Ankita are very connected with rural schools, and teachers will relate directly to them. The article 'Why Add Eggs to Midday Meals' will help in discussing food habits and logic of giving eggs in mid-day meals, and articles 'Exploring the Sun's path with Stellarium' and 'Understanding GBS' can be helpful for teachers who are slightly exposed to urban diseases, terms, apps, etc. But yes, activities given at the end of all articles provide a balanced approach on using the articles where all teachers irrespective of region, status of schools etc., can use activities by adding their inputs. Or resource persons can help them in visualizing these. For example, activities in the article 'Observing Neighbourhood Birds: The Meditating Heron' are very useful for all kinds of schools. Similarly, the idea of using pictures of women scientists for an activity is also adding a horizon to students' understanding of scientists. In the article 'The Importance of Asking for Questions in Different Ways' too, we get some good ideas to frame questions and ask students to frame questions and analyze what a scientific question is. On features, I can say some more direct relevant questions and articles considering the common teachers of schools of small villages and towns will help. For example, working on the microscope, using physics experiments such as playing with lenses, and electricity related topics can help them to work on hotspots of school science. I found that most teachers struggle with such topics. Also, can we write more articles on model making and include science cartoons kind of things which can also provide ideas that support creativity in science. We used 'Understanding GBS'... , but articles on more common diseases in rural areas and small towns can help teachers visualize activities that students can connect with more strongly. There are some topics related to biological processes like reproduction, adolescence, respiration, circulation etc., where we all struggle to tackle misconceptions and alternative concepts. And we do not know the realities even after doing MSc with the biological sciences. So can we also focus on articles on these topics so that students can understand scientific knowledge and can connect that learning with daily life. For example, periods (menstruation) are a common, but boys and girls both do not know many scientific things about the topic. On writing style: connections should come in flow instead of the sudden pop up of lines like 'see this in activity sheet 1, 2 etc.' Also, the boxes suddenly come in between the flow of the text. In scientific papers sometimes it becomes tough to refer things by leaving the coherence of reading. So, if boxes come at the end, then flow will be fine."—Mohammad Zafar, Azim Premji Foundation, Uttarkashi, Uttarakhand.

"I used the article 'Pedagogy of Making: Pinhole Camera' while teaching the chapter on Light to Grade VI students. The article helped children develop an understanding of reflection of light. More experiments that can be done in the classroom can be included in the magazine. For example, if there is an alternative to iodine test to check for starch in plants/leaves, then it would be really helpful for teachers as well as Foundation members. More articles like this about simple ways of carrying out the activities given in the textbook are needed."—Sakshi Patel, Azim Premji Foundation, Chittorgarh, Rajasthan.

"Teachers commonly say that there are no red and blue litmus papers in their school. I used the article 'Exploring Acids & Bases with Natural Indicators' in a workshop. I discussed what are natural indicators and how we can test acids and bases without litmus paper. Teachers then explored books and collected Gurhal flowers and turmeric. They made turmeric paper, carried out experiments with it and filled a checklist... Like the acid-base activity with natural indicators, activities around physical and chemical change; living and non-living; magnetic and non-magnetic objects; pressure; temperature, etc., may be included in the magazine. These will be very helpful to carry out in the classroom and with teachers at minimum cost. Some articles on the use of science in traditional living style may be helpful. For example, how do natural preservatives work; how earthquake-resistant designs of houses are sustainable in hilly areas; what are the

alternatives to fridge and soap in villages; how were grains stored safely for long periods. Articles presenting perspectives on issues like science and society may be included". –Manoj Kumar, Azim Premji Foundation, Haridwar, Uttarakhand.

"During school visits, activity sheets from the magazine were used for science classes in Grades VI to VIII in 20 schools. The activity sheets were also used by teachers. The article '[NCF-SE in Classroom Instruction](#)' was used in a modified form in the monthly follow-up meeting of science teachers in Pathariya block. In this meeting, 30 teachers read and understood this article. I suggest that activity sheets based on science themes for Grades VI to X, that can be used directly in the classroom, should be included in i wonder..." –Satish Bhaskar, Azim Premji Foundation, Damoh, Madhya Pradesh.

"The article 'The Importance of Asking Questions in Different Ways' helped in developing better understanding for my short session in a summer workshop for tecahers, where I tried to highlight the role of a science teacher in developing the temperament of scientific questioning among learners. I used to start classes with introductory questions. But as suggested in the article, I started a class during a school visit by demonstrating a fun activity that engaged students' interest before moving to the main topic. While facilitating a session on a project-centric approach, I used the article 'The NCF-SE in Classroom Instruction' to briefly discuss the importance of reading the NCF-SE 2023 and how it will help a science teacher to more effectively achieve learning outcomes (LOs). The classroom resources provided in the article 'Exploring Acids & Bases with Natural Indicators' are effectively curated and have high relevance in meeting students' learning levels. The activities are interesting and easy to perform." –Manisha Mall, Azim Premji Foundation, Uttarkashi, Uttarakhand.

"Suggest including articles that review chapters in the textbook in the light of the NCF-SE 2023. Illustrations can be made more contextual and related to the lives of the learners with whom we work in the field." –Piyush Joshi, Azim Premji Foundation, Nainital, Uttarakhand.

"I used the article 'Why Add Eggs to Midday Meals' from the Apr 2025 issue in the classroom to discuss the importance of proteins and its sources. I displayed the comparison between nuts, eggs, and other sources in the Grades VI, VII and VIII classrooms. The activity around the biography of scientists was done in two workshops held in May 2025, while discussing the project-based approach described in the article 'A Project-centred Approach to Biographies of Scientists'. Everything is fine in the magazine, keep it up! Thanks everyone for such great work! This magazine, dedicated to school science, is the first of its kind that I have come across."– Mukesh Sati, Azim Premji Foundation, Champawat, Uttarakhand.

"I have used some content from four articles in my field engagements: Pedagogy of Making Pinhole Camera, Doing science without labs, Why Add Eggs to Midday Meals, and Exploring Acids & Bases with Natural Indicators from the Dec 2024 and Apr 2025 issues. I have used these with teachers and students of Grade VI to X, some directly and some with modifications. For example, I have used the Activity Sheet: Be an Indicator Jasoos! as an introductory activity on indicators with students in the classroom. I used the article Why Add Eggs to Midday Meals in a teacher engagement. This article has an insightful table that gives information on the nutritional value of various food materials. Teachers get insights about a balanced diet. Both the Dec 2024 and Apr 2025 issues are quite interesting and useful for field engagements. Language is easy to understand and activity sheets for classroom engagements are insightful for both teachers and students. A few suggestions based on field experiences: Articles around health and hygiene that also include few adolescent issues can be included in the next edition. Activity sheets and teacher note for classroom interactions will also be helpful."–Priyanka Joshi, Azim Premji Foundation, Pithoragarh, Uttarakhand.

"I used 'The Pedagogy of Making: Pinhole Camera' and 'The NCF-SE in Classroom Instruction' in an internal capacity-building workshop. Members constructed a pinhole camera and engaged with the concept and principle behind it. The article around NCF-SE helps in understanding the aim of science education and learning standards (curricular goal, competencies, learning outcomes). Discussing the article 'Doing Science without Labs' with internal members and teachers helped them come up with ideas about developing science labs in schools. During a cluster-level academic meeting, I used an activity sheet from the article 'Observing Neighbourhood Birds: The Meditating Heron' to discuss ways of encouraging observation of organisms in our surroundings (The World Around Us, Grades III to V)."–Avneesh Shukla, Azim Premji Foundation, Barkot, Uttarakhand.

Share your feedback

Would you like to share anything from your classroom experiences that would help other teachers use the articles and resources from our Aug 2025 issue more effectively in their classroom practice? Tell us. Your feedback will be published in our Apr 2026 issue.

You can share your feedback for the:

- English edition of our Aug 2025 issue here: https://forms.gle/E3AY6qv6RNxRBfVeA
- Hindi edition of our Aug 2025 issue here: https://forms.gle/vyEB9H4ChLELsszG6

You can also write to us at iwonder@apu.edu.in.

Connect with Us

Read

We publish three issues (Dec, Apr, and Aug) a year. Every issue is available in **English, Hindi,** and **Kannada.** Each issue features a combination of articles and detachable classroom resources (like Activity Sheets, Student Handouts, Teacher's Guides, Booklets, Posters, or Field Guides). These are included under sections like: The Science Educator at Work, Life in Our Backyard, Annals of History, The Science Lab, Perspectives, Resource Review, Teaching as if the Earth Matters, and Ask a Question. All **our content is CC-licensed and freely available** on our website.

Ask and discuss

Share your questions with authors in our free, live, online discussions. Here are some examples:

- **How do children know the Earth is not flat?** (URL: https://www.youtube.com/watch?v=gMKyAZuu4tY) with Anand Narayanan and Amol Anandrao Kate.
- **Why science matters** (URL: https://www.youtube.com/watch?v=KeJIBY1IqpM) with Anil Kumar Challa, Reeteka Sud, and Vinay Suram.
- **Plants and pollinators: Let's explore** (URL: https://www.youtube.com/watch?v=cqYu1zwmLX0&t=9s) with Meenakshi and Radha Gopalan.
- **Exploring motion through a balloon's flight** (URL: https://www.youtube.com/watch?v=NgIRXGDpnfw) with Anish Mokashi and Vinay Suram.

Find us

To **download full issues (English)**, visit: https://azimpremjiuniversity.edu.in/iwonder....

To **download individual articles (English)**, visit: https://publications.azimpremjiuniversity.edu.in/view/university_publications/fiel18=2E1/.

To **download individual articles (Hindi and Kannada)**, visit: https://anuvadasampada.azimpremjiuniversity.edu.in/view/divisions/iWonder/.

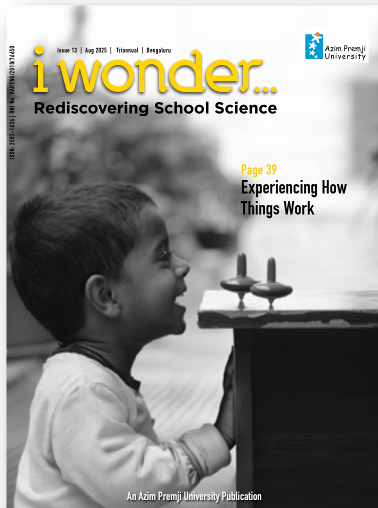
To **watch recordings of our online discussions**, visit: https://www.youtube.com/playlist?list=PLVI4qkjTdM73ovqKxvqPkDslbG22bKXyP.

To **get updates** on upcoming issues and online discussions, register here: http://bit.ly/iwonderRegister.

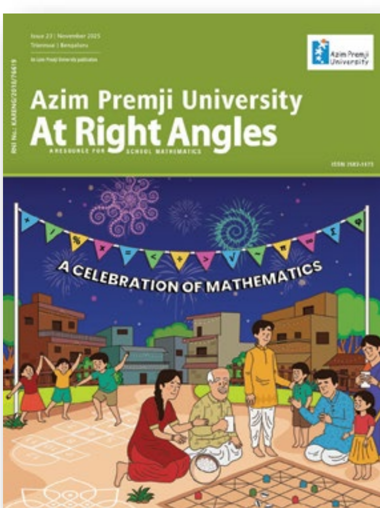
Printed and published by Rishikesh BS, Registrar, on behalf of Azim Premji University. Survey No 66,
Burugunte Village, Bikkanahalli Main Road, Sarjapura, Bengaluru, Karnataka 562 125.
Printed at: Repromen Offset Printers Pvt. Ltd., #46/47, 3rd Cross, Krishna Reddy Colony, Domlur Layout, Bengaluru, Karnataka 560071
Editor: Chitra Ravi.

Azim Premji University

Magazines for School Education



Scan here to subscribe
for i wonder... Magazine



To know more about other publications, write to us: publications@apu.edu.in

Curious about constellations? Check out our Apr 2026 issue.

Azim Premji University
Survey No. 66, Burugunte Village
Bikkanahalli Main Road, Bengaluru - 562125
Facebook: /azimpremjiuniversity
Instagram: @azimpremjiuniv
Website: azimpremjiuniversity.edu.in
Youtube: @azimpremjiuniversity
X: @azimpremjiuniv

233121